MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for August, 1901, is based on reports from about 3,100 stations furnished by employees and voluntary observers, classified as follows: regular stations of the Weather Bureau, 159; West Indian service stations, 13; special river stations, 132; special rainfall stations, 48; voluntary observers of the Weather Bureau, 2,562; Army post hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Railway Company, 96; Hawaiian Government Survey, 200; Canadian Meteorological Service, 32; Jamaica Weather Office, 160; Mexican Telegraph Service, 20; Mexican voluntary stations, 7; Mexican Telegraph Company, 3; Costa Rica Service, 7. International simultaneous observations are received from a few stations and used, together with trustworthy newspaper extracts and special reports.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Meteorologist to the Hawaiian Government Survey, Honolulu; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Mr. Maxwell Hall, Government Meteorologist, Kingston, Jamaica; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Commander Chapman C. Todd, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San Jose, Costa Rica; Captain François S. Chaves, Director of the Meteorological Observatory, Ponta Delgada, St. Michaels, Azores, and W. M. Shaw, Esq., Secretary, Meteorological Office, London; Rev. Josef Algué, S. J., Director, Phillipine Weather Service.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is 157° 30′, or $10^h\ 30^m$ west of Greenwich. The Costa Rican standard of time is that of San Jose, $0^h\ 36^m\ 13^s$ slower than seventy-fifth meridian time, corresponding to $5^h\ 36^m$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now always reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

During the temporary absence of Professor Abbe, Mr. H. H. Kimball has been appointed Acting Editor of the REVIEW.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

The first month of the season of tropical storms passed without the occurrence of gales of hurricane force at any of the islands of the Greater or Lesser Antilles. The most important storm of the month first appeared as a feeble disturbance in the subtropical region north of Cuba on the morning of the 9th. By the morning of the 10th this disturbance had advanced to the extreme southern part of the Florida Peninsula, with an apparent slight increase in energy. At that time the following advisory message was sent to all Florida stations, and also to Savannah and Charleston:

> Disturbance of moderate strength central off southeast Florida coast. May cause squalls dangerous to small sailing craft along Florida coast and over western Bahamas.

During the next twenty-four hours the center of disturbance moved slowly northwestward to the Florida coast south of Tampa, and on the morning of the 11th, the following advisory message was sent to Gulf and south Atlantic stations from New Orleans to Charleston:

> Disturbance of slight extent central this morning off the west Florida coast; evidently moving northwestward; may cause severe squalls this afternoon and to-night on the west Florida coast.

By the morning of the 12th the center of the disturbance had advanced to a position over the eastern part of the Gulf of Mexico, with an apparent increase in energy, and coast stations from New Orleans to Jacksonville were again advised of the position and character of the storm. The regular morning and special reports of the 13th showed the advance of the storm toward the mouth of the Mississippi, and at 8 a. m. a wind velocity of 48 miles an hour from the northeast was reported at Port Eads. On that date southeast storm warnings were ordered on the west Florida, Alabama, Mississippi, and Louisiana coasts, and the following message was telegraphed to west Florida and Alabama ports:

> Storm center apparently approaching the mouth of the Mississippi. Considered dangerous for vessels bound for middle and west Gulf ports.

Stations on the Louisiana and Mississippi coasts were notified that the storm was increasing in intensity, and would probably cause brisk to high northerly winds the day and night of the 13th.

At 8 a. m. of the 14th Port Eads reported a current wind velocity of 60 miles an hour from the southeast, with a maximum velocity during the preceding twelve hours of 72 miles

an hour from the southeast. Storm warnings were continued along the middle Gulf coast, vessels were again advised that it would be unsafe to leave port, and railroad and other interests were notified that a severe storm and high water were indicated. By the morning of the 15th there was every evidence that the storm possessed hurricane force. Stations on the west Florida and Alabama coasts were informed that the storm would be very severe and dangerous for any class of vessels. The forecast official at New Orleans was authorized to order, at his discretion, hurricane warnings on the Gulf coast from the mouth of the Mississippi westward, and was directed to notify, by all available means, points in Louisiana and Mississippi that severe gales and heavy rain would occur during the next twenty-four hours. Similar advices were also telegraphed throughout Alabama. During the next twenty-four hours the center of disturbance crossed the coast line somewhat to the west of the mouth of the Mississippi, and advanced thence northward over east central Mississippi, where it was central at 8 a. m. of the 16th.

After passing into the interior, the storm showed a rapid decrease in strength. At New Orleans the barometer fell to a minimum of 29.41 inches at 9 a. m. of the 15th, and the maximum wind velocity recorded on that day was 49 miles an hour from the northeast, at 9:35 a. m. At Mobile the storm was most severe from 5:15 to 6:30 p. m. of the 15th, and the wind attained its greatest velocity, 60 miles an hour from the southeast, at 5:50 p. m., with an extreme velocity of 78 miles an hour. Between the hours of 5 and 7 p. m., the wind velocity averaged from 50 to 60 miles an hour. From a short distance west of the mouth of the Mississippi River to a point somewhat to the east of Pensacola, Fla., the storm was very destructive. The forecast official at New Orleans reports that the estimated damage to property on the Louisiana coast amounted to more than $1,000,000, exclusive of the damage to growing crops. The official in charge at Mobile reports that, according to the estimate of the secretary of the Chamber of Commerce, the value of property saved by the warnings of the Weather Bureau aggregates several millions of dollars.

A detailed description of this storm will be found in the following reports submitted by the Weather Bureau officials at New Orleans and Mobile.

Report by Dr. Isaac M. Cline, Forecast Official, New Orleans, La.:

The 8 a. m. weather map of August 12, 1901, showed a general barometric depression over the Gulf States, and there were conditions along the Gulf coast which indicated that a storm was probably developing in the central Gulf. Attention was called to this in the general forecast at 8 a. m., August 12, and shipping interests were advised to be on the alert.

1 p. m. special observations were called for on this date, but they revealed no material change since morning in the conditions. Some tugs and barges were, however, advised not to go into the Gulf, and the advice was heeded. At 8 p. m. the lowest barometer was 29.82 at Galveston.

The 8 a. m. reports of August 13 showed a storm developing in the central Gulf off the mouth of the Mississippi River, and the following was issued and distributed:

"Storm northeast, 9 a. m., stations along the Louisiana and Mississippi coasts. Disturbance in the Gulf off the mouth of the Mississippi River, increasing in intensity; will probably cause brisk to high northerly winds to-day and to-night."

Several tugs with fleets of barges were held in the basin on the advice of the Weather Bureau. The New Orleans agent of a steamship line, running to Tampico, Mexico, after consulting the Weather Bureau officials over the telephone, wired his correspondent at the latter place to hold his vessel until further notice from the Weather Bureau.

By 8 p. m. the storm had developed considerable intensity. The wind at Port Eads was blowing 48 miles an hour from the northeast. No report was received from Port Eads on the morning of the 14th. The following warning was issued and distributed:

"Continue storm northeast, 9 a. m., along Louisiana and Mississippi coasts; disturbance central in Gulf, off Louisiana coast, moving north; will cause high winds, shifting to west."

All the railroads running into southeast Louisiana and southern Mississippi were requested by telephone to send notice to their agents in these districts that a severe storm and high water were indicated and to be on the alert and prepare for the same. The officials of the companies distributed the information promptly.

By 8 p. m. August 14 the storm had spread into the west Gulf, with the barometer reading 29.66 inches both at Galveston and New Orleans. Notwithstanding the barometric gradients to the westward were slight, storm northeast signals were ordered at Galveston and Sabine Pass, Texas.

At 8 a. m. August 15 the report showed a well-defined hurricane in the Gulf off the coast of Louisiana, and moving slowly toward the northwest. The following warning was issued:

"Continue storm northeast along the Louisiana and Mississippi coasts; storm increasing in severity and moving northward; high northeast to east winds and high water will continue to-day and probably to-night; the tide has risen 7.4 feet in 48 hours."

The following was received from Washington, 10.53 a. m.

"At your discretion order hurricane warnings on the Gulf coast from Mississippi westward; storm undoubtedly of great intensity and will strike the coast between the mouth of the Mississippi River and Galveston. GARRIOTT."

It was my desire to wait until receipt of 1 p. m. specials, which had been called for, before issuing a hurricane warning for the east Texas coast, but I learned that all the telegraph wires east had gone down, and that only one or two wires north and west remained. On account of the threatening conditions and the probability of all wires going down and making it impossible to get warnings out, I issued a warning at once for the territory between the mouth of the Mississippi River and Galveston, as follows:

"Hoist hurricane signals 11 a. m. along Louisiana and east Texas coasts; storm off the Louisiana coast undoubtedly of great intensity and moving northwest; will probably strike the coast between the mouth of the Mississippi River and Galveston, causing hurricane winds from an easterly direct on on the Louisiana coast and northerly on the east Texas coast."

This warning was supplemented by the following advisory message sent to Galveston:

"Only high north winds indicated for east Texas coast, which will give low water at Galveston."

This was also given to the press so as to allay the fear of those interested in Galveston who would probably read of the storm in the Gulf.

The storm blew with great fury along the immediate coast of Mississippi and Louisiana, commencing on the afternoon of the 13th and continuing through the 14th and 15th. The high wind was not felt at New Orleans until the afternoon of the 14th.

The following are the essential features of the weather at New Orleans on the 14th and 15th:

August 14.—Cloudy, damp, cool, and windy weather; 10 strato-cumulus from northeast at 8 a. m.; 6 alto-stratus from west and 4 cumulus from northeast at 1 p. m.; 10 cumulus from northeast at 4 p. m. and 10 strato-cumulus from northeast at 8 p. m. At 8 a. m. the barometer reading was 29.703; at 1 p. m., 29.720; at 4 p. m., 29.671; at 8 p. m., 29.653, and at midnight, 29.650, which was the lowest reading for the day. The wind blew steadily from the northeast throughout the entire day; at 8 a. m. the velocity was 9 miles an hour; at 1 p. m. and 4 p. m., 20 miles; at 6:40 p. m., 32 miles, and at 8 p. m., 24 miles. Highest velocity for the day, 32 miles an hour. Light showers occurred from 1 to 5:55 a. m., 7 to 7:40 a. m., 8:26 to 9:15 a. m., 10:20 to 11:40 a. m., 12:40 to 2:40 p. m., 5:10 to 5:20 p. m., 6:05 to 7:55 p. m., and from 9:05 p. m. till past midnight. Total rainfall for the day, 0.78 inch. The Mississippi River at this point rose 1.9 foot in the twenty-four hours ending at 8 a. m., and to a stage of 5.9 feet, and two hours later had risen to 7.1 feet, due to the backing of the water, and continued to rise.

August 15.—Wet and stormy morning and forenoon; cool, overcast, and stormy in the afternoon till about 5:45 p. m., when the sun broke through the clouds in the northwest; the evening was cool, partly cloudy, damp, and comparatively quiet. Clouds: 8 a. m., 10 strato-cumulus from northeast; 1 p. m., 10 strato-cumulus from north; 4 p. m., 10 nimbus from northwest; 8 p. m., few cirro stratus from southwest and 9 strato-cumulus from northwest. At 8 a. m. the barometer reading was 29.431 inches, having fallen steadily all the morning; at 9 a. m. it was 29.410, the lowest recorded during this storm; after this it began to rise; at 1 p. m. it was 29.461; at 4 p. m., 29.516; at 8 p. m., 29.566, and at midnight, 29.650. The wind blew steadily from the northeast from early morning till about 10 a. m., then it backed to north with occasional gusts from northeast till about 11:55 a. m., when it backed to northwest for a few minutes; from this time till about 3:45 p. m. the wind blew mostly from north-northwest, and during the remainder of the day from northwest with decreasing energy. From 12:01 to 8 a. m. the wind velocity was from 20 to 35 miles an hour from northeast; at 9:35 a. m. there was a severe squall, during which the wind reached a velocity of 49 miles an hour from northeast.; this was the highest velocity recorded for the day; at 1 p. m. the wind was 40 miles from north; at 4 p. m. it was only 24 miles from northwest; at 8 p. m., 15 miles from northwest, and at midnight 8 miles west.

To-day's windstorm is the severest experienced in this city since

1870 with one exception, August 19, 1888, when the wind blew at the rate of 60 miles an hour from the east. The rain that began at 9:05 p. m. yesterday ended at 7:30 o'clock this morning; light showers occurred from 8:26 to 9 a. m., 11:15 a. m. to 12:40 p. m., and 2 to 5 p. m. Total for the day, 0.59 inch. The Mississippi this morning stood at a stage of 11.4 feet, a rise of 5.5 feet in the past twenty-four hours; soon after noon the river began to fall, and after 4 p. m. it fell rapidly.

During August 13 and up to the afternoon of the 14th the storm moved northward. At 8 a. m. of the 14th the wind at Port Eads had changed by the way of the east to southeast, with a maximum velocity of 72 miles an hour. This, with other reports, showed that the storm had moved to the westward of that place. The 8 a. m. reports of the 15th showed the storm moving toward the northwest. During the evening of the 15th the storm changed its course from northwest toward the northeast. The center of the storm appears to have struck the coast of Louisiana to the west of the mouth of the Mississippi River, as forecast in the hurricane warning. It then moved toward the northeast over southeastern Louisiana, the center probably passing between New Orleans and Port Eads, across southern Mississippi into Alabama, and thence northward up the Mississippi Valley.

EXTENT OF DAMAGE.

Much damage and loss of life was reported. It is estimated that the damage to property on the Louisiana coast will amount to more than $1,000,000, exclusive of the damage to growing crops, which can not be estimated.

The greatest damage in the vicinity of New Orleans occurred at Milneburg and Bucktown, on the shores of Lake Pontchartrain. The West End suffered serious damage. The Old Basin overflowed its banks and inundated a large section of the city, causing much damage, especially in the vicinity of Treme market, where the streets were covered with water from 1 to 3 feet deep. The Orleans levee board and the city authorities, acting upon information given out by the Weather Bureau, had a force of 500 men at work strengthening the canal levees. By noon of the 15th the water in the basin began to recede, and by sundown it had ceased to flow over its banks.

All the towns south and southeast of New Orleans suffered seriously; also all towns along the Mississippi coast. Only 10 persons are known to have perished, but more lives no doubt were lost. Railroads east and north suffered serious damage. Mail communication with the East was cut off on the night of the 13th and has not yet been restored, August 17.

The warnings issued by the Bureau, well in advance of the hurricane, and the advice that conditions were very threatening, are credited with saving many lives and a vast amount of property, as the following editorial from the Daily States of August 15 indicates:

"SERIOUS DAMAGE PROBABLE."

"The severe storm which has been raging over the Gulf coast of the Southwest during the past two days is quite likely to furnish a chapter of unpleasant reading when all the reports have been made up. The continued force of the wind and wave has resulted in producing a serious situation all down the lower coast, where the water has been backed up even higher than was the case in the great Chenier Caminada disaster, which occurred in October, 1893, and destroyed so many lives. It is greatly feared that the loss of life among the fishermen and others who make their temporary habitation on the low-lying coast and the adjacent islands will be considerable.

"Fortunately, the splendid service of the Weather Bureau, by the timely notice it sent out of the approaching storm, gave many an opportunity to secure protection, and the consequent disaster will be much smaller than would have been the case had the storm broken upon the coast without warning. Communication with many important points is difficult, owing to the fact that the wires are prostrated, but if the storm has prevailed over the principal sugar and rice districts with anything like the same force that characterized its passage over the coast sections the damage to the crops must be considerable.

"The rice crop throughout Louisiana and Texas is just in that condition where the ripening grain will cause the stalks to succumb to heavy winds, and it is feared that the loss resulting will be considerable. The sugar-cane and cotton crops will probably come out better than the rice, by reason of the fact that these crops have not reached that advanced stage of ripeness where the injury done would be irreparable. The chief damage to be apprehended is to life and shipping on the coast and in the Gulf and to the great rice crops of Louisiana and Texas.

"It is sincerely to be hoped that the early and accurate warning given by the Weather Bureau enabled most of those exposed to seek places of safety, which appears to have been the case from reports brought in by several who were on the lower coast at the beginning of the storm."

The Times-Democrat of August 15, 1901, published the following regarding action taken as a result of the warnings:

"High winds prevailed along the coast yesterday afternoon and last night, and the warning sounded by the New Orleans Weather Bureau office was amply justified.

"The advice which Forecast Official Cline gave the owners of vessels of various kinds to keep in port was heeded, and this fact probably tended to minimize the damage resulting from the high wind.

* * * * * * *

"The timely warning sent out by the Weather Bureau officials yesterday saved many of the vessels from the storm. The Weather Bureau office here early yesterday notified all points all along the Louisiana and Mississippi coast to advise ship owners not to send their vessels to sea. This warning was heeded, for about twelve steamers were stopped at the Head of the Passes and cast anchor, and will remain in the river until the storm has passed over.

"At 4:30 o'clock the Weather Bureau reported the storm to be increasing. The last information received was that the wind was sweeping off the Passes at the rate of 48 miles an hour. It had increased greatly in velocity, and was growing greater in its force all the time.

"The storm was reported to the Weather Bureau officials as being centered south and central of the Passes. It was moving slowly northward

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"'It is by far the worst storm of the season,'" said Captain Ward, of the steamer *Lawrence*, last night, "'and I am afraid the worst is yet to come. So far as I have been able to learn there are no boats out on the lake, as the warning came in time.'"

The Picayune of August 17, 1901, says:

"The merchants along the river front took advantage of the timely warnings of the Weather Bureau, and got their goods up on platforms above high-water mark; so that, comparatively speaking, the damage to stocks of merchandise is small."

The Picayune of the same date, in publishing a sketch of the warnings issued by the Weather Bureau in connection with this storm, says:

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"The lesson to be drawn from the above story should be one of confidence on the part of the people in the great and important work done by the Weather Bureau. The uses made of the daily forecasts are so numerous and well known as to call for no remark; but the value to the manifold business interests of the country of the publication of the weather data and the dissemination of the warnings of exceptionally severe and injurious weather conditions should be as fully appreciated as it deserves. Warnings of storms and hurricanes, issued for the benefit of marine interests, are most important and pecuniarily valuable."

The Daily Item of August 17, 1901, makes the following editorial comment:

"The Weather Bureau, by the timely notice it sent out of the approaching storm, gave many an opportunity to secure protection, and the consequent disaster was much smaller than would have been the case had the storm broken upon the coast without warning."

Supplementary report by Mr. H. F. Alciatore, temporarily in charge, New Orleans, La.:

I have the honor to submit the following additional report on the effects of the hurricane of August 13-16, 1901, at the mouth of the Mississippi River, based on mail advices and telegraphic reports from our displayman at Port Eads and Pilottown, La.:

At 8 p. m., August 13, 1901, the barometer at Port Eads was 29.66 inches, and the wind was blowing from the northeast at the rate of 48 miles per hour. Later in the evening the wind increased in force and the telegraph and telephone lines were prostrated and have remained down ever since. At 8 p. m., August 14, a report was filed at the telegraph office by the displayman but was never sent, the line being down. This report showed that the barometer was 29.50 inches, wind from southeast, 60 miles per hour, and that some time during the day the wind had reached a maximum velocity of 72 miles per hour from the northeast.

During the night of the 14th and morning of the 15th the anemometer cups were blown away and the anemometer support knocked down, from which it would appear that a hurricane velocity in excess of that reported in the 8 p. m. observation of the 14th must have occurred. The instrument shelter was washed away. The flagstaff was broken by the wind and fell to the ground. The office building (a small cabin Carre) weathered the storm, but the papers and records therein were soaked with water.

At Pilottown, La., about 12 miles up the river, the storm was equally severe. The large and substantial "lookout" tower from which storm flags were displayed was blown down (probably on the night of the 14th) and completely wrecked. The outhouse in which our displayman was accustomed to sleep was blown down and rapidly filled with water, the tide having risen about four feet in about ten minutes, and property belonging to the Weather Bureau was ruined. The storm-warning lanterns, property of the Bureau, are however, reported to be in good condition. The displayman reports that "it blew a hurricane here (Pilottown) for twenty-four hours from northeast to east-southeast.

Report by Mr. William M. Dudley, official in charge, Mobile, Ala.:

One of the most interesting storms in the meteorological history of this section occurred Thursday, August 15, 1901. On Sunday morning, the 11th, the following advisory message was received from the Central Office, and furnished the public:

"Storm warning at 10:15 a. m., disturbance of slight extent central this morning off the west Florida coast, evidently moving northwestward. May cause severe wind squalls this afternoon and to-night on the west Florida coast."

During Monday, August 12, fresh southerly winds prevailed, with light thunder squalls from the southeast during the afternoon. The following message was received from the Central Office at 3:10 p. m.:

"Advisory 3 p. m., disturbance over eastern Gulf. No evidence of marked energy as yet, but may develop, causing squalls dangerous to small sailing craft in east and middle Gulf."

This information was given out and published by the afternoon press.

On Tuesday, August 13, the storm was central in the middle Gulf, south of Port Eads, La., and at 10:45 a. m., the following message was received from the Central Office:

"Advisory, storm central south of Port Eads, increasing in intensity; will probably move up the Mississippi Valley, and may cause brisk easterly to southeasterly winds on the west Florida, Alabama, and Mississippi coasts."

This information was printed on the morning weather map, sent out over the telephone, and published by the afternoon press. The conditions becoming more threatening as the day advanced the Central Office sent out the following information, received here at 2:10 p. m.:

"Southeast storm warning 2 p. m., Mobile, Pensacola, storm center apparently approaching the mouth of the Mississippi. Considered dangerous for vessels bound for middle and west Gulf ports."

The warning was hoisted at once, and the information given to the public by bulletins, and through the afternoon papers. Several ship captains were advised not to sail.

Light rain began at 11 p. m., of the 13th, and ended at 12.30 a. m. of the 14th; began again at 7:40 a. m., and ended at 7:42 a. m.; amount at 8 a. m., 0.02 inch. A rainbow was observed in the west at 7:40 a. m. Fresh to brisk southeast winds during the night, increased to high during the morning of the 14th, and with the incoming of the tide backed the water of the bay into the river. By noon the water had come awash of the top of the wharfs along the city front, causing some apprehension to business houses located thereon. The office was crowded with people and the telephone rang continually. The southeast wind increased, attaining a maximum velocity of 42 miles per hour at 12:55 p. m., attended by heavy rainfall. Brisk southeast winds prevailed after 1:45 p. m., with showers at intervals, varying from light to heavy. The following message was received from the Central Office at 3:23 p. m.:

"Continue southeast storm warning 3 p. m. Storm central near mouth of Mississippi, apparently moving northward. Unsafe for vessels to leave for west Gulf points this evening or to-night."

This information was distributed by telephone and bulletins. Rain ended at 6 p. m., the amount to 8 p. m. being 0.40 inch. Cloudy and threatening weather all the evening, and fresh to brisk southeast winds to midnight.

On the 15th light rain began at 12:50 a. m. and continued in showers varying from light to heavy through the night, with wind in gusts, varying from fresh to brisk; amount of rain at 8 a. m., 1.67 inch. The day opened stormy and threatening, with high southeast winds after 6 a. m., which attained a maximum velocity of 36 miles per hour at 7:05 a. m.; decidedly cooler, the maximum temperature for the day being 76° and the minimum 74°. There was a slight lull in the wind from 7:30 to 8:40 a. m., when it increased suddenly, attaining a maximum velocity of 41 miles southeast at 8:42 a. m.; it continued high southeast to noon. The barometer fell all the forenoon, and read 29.74 inches at 8 a. m. and 29.65 at noon. The following readings were made during the afternoon, all readings being reduced to sea level: 3 p. m., 29.60; 3:30 p. m., 29.54; 4 p. m., 29.50; 4:30 p. m., 29.47; 5 p. m., 29.42; 5:30 p. m., 29.38; 6 p. m., 29.34; 6:30 p. m., 29.32; 7 p. m., 29.32; 7:30 p. m., 29.32; 8 p. m., 29.32, and 9 p. m., 29.33 inches. All telegraph wires were working badly, and our circuit reports were not received until 11 a. m. On the weather map the following advice was given the public:

"A storm of severity shows on this morning's chart in the vicinity of New Orleans, La. High southeast winds will prevail throughout the day, causing continued high water on the river front at Mobile, Ala., and it is deemed advisable for persons holding perishable goods to move them to a place of safety, as the full intensity of the storm has not been felt, and every indication shows that in its movement it will cause dangerous gales along the coast."

The office was crowded with representatives of business houses on the river front, the telephone rang continually, and merchants prepared to elevate goods on the river front.

The following advisory message was received from the Central Office at 11:20 a. m.:

"Center of Gulf storm approaching coast between mouth of Mississippi and Galveston. Storm becoming very severe. Dangerous for vessels of any class to sail westward to-day."

This information was issued by the afternoon press, to those seeking information at the office and over the telephone, to vessels on the river front, and to interested persons in general. At 1 p. m. the following was telegraphed to Washington:

"Water over wharf, and three blocks up in the city. Everyone previously warned to move goods."

An effort was made to get information from Fort Morgan, Ala., 30 miles down the bay, on the Gulf, but the wire had been down since early in the morning.

An order from the Central Office to continue southeast storm warning at 3 p. m. was received at 2:30 p. m.:

"Continue southeast storm warning 3 p. m. Hurricane warnings were ordered this morning on Louisiana and east Texas coasts. Storm apparently increasing in intensity. Violent southeast gales will shift to-night to southerly and southwest on Mississippi, Alabama, and northwest Florida coasts."

This information was distributed by the afternoon papers and by bulletin and telephone. Many persons were in the office waiting for advices regarding the storm, and as a result of this warning additional precautions were taken for the removal of goods to higher elevations. It was impossible to send this warning and the advisory message previously received to Biloxi, Scranton, and Fort Morgan, our subdisplay stations, as all wires were down to points west and south of Mobile.

The rain became heavy at 11 a. m., increased with the wind at 3 p. m., and continued until 7 p. m., when the wind shifted to south; total fall from 8 a. m. to 8 p. m., 3.79 inches. Rainfall for twenty-four hours ending 8 p. m. 16th, 5.44 inches; total from the beginning of the storm, 5.84 inches.

The barometer fell at the rate of .05 inch per hour until 6 p. m., and then continued stationary to 8:30 p. m., when the wind shifted to southwest. The barometer then rose rapidly, and watchmen on the river front were informed that the danger had passed.

The wind continued brisk to high southeasterly throughout the afternoon, increased in force after 4 p. m. and continued high until 7 p. m. The storm was most severe from 5:15 to 6:30 p. m., and the time of highest velocity was 5:50 p. m., when a maximum of 60 miles southeast occurred, with an extreme velocity of 78 miles. The wind velocity averaged from 50 to 60 miles an hour between 5 and 7 p. m. After the wind changed to southerly at 7 p. m. it showed a gradual decrease to 22 miles southwest at midnight.

The greatest source of damage feared from the storm was the backing of water into the river, and this continued during the 14th and 15th. The water had been awash of the wharfs from 12 m. to 1 p. m. of the 14th. At 10 a. m. on the 15th it began to come over the wharf, and from this time on it came in very rapidly, rising at the rate of 1 foot an hour. By 1 p. m. it had come up into the streets three blocks above the river front. At 3:30 p. m. the water was 5 feet over the wharf and it continued to rise until 7 p. m., reaching to within half a block of the Government Building, which is located five blocks from the river front. Boats were going about this part of the city. The water began falling when the wind shifted to southerly at 7 p. m. and fell at a rate of about 1 foot an hour.

The height of the water did not equal by 1 foot the stage reached during the hurricane of October 2, 1893. During that memorable storm the water was 6 feet over the wharf, the maximum wind 72 miles southeast, with an extreme velocity of 80 miles, and the water reached the street car tracks on Royal street, one-fourth block farther up than during the recent storm.

During the storm business was suspended throughout the day; merchants everywhere gave heed to the warnings, and as soon as they were received began to move all perishable goods to a safe elevation.

People waded waist deep, directing the moving of goods. Merchants who came to this office late in the evening informed me that, owing to the Bureau's warnings, their losses would be slight.

The warnings issued by the Bureau during the approach of this storm constituted a chain of perfect links. The work of the Bureau was highly commended and appreciated by the community, and merchants do not hesitate to admit that, had they not been notified, their losses would have been incalculable.

The street cars stopped running at 3 p. m. Boats in the river went up to Twelve Mile Island to a safe anchorage. Everything in port was tied fast. No trains arrived during the 16th, and none left.

The office force remained on duty until 12 midnight, when all danger of the storm had passed.

The wind continued fresh from the southwest through the night, and on the morning of the 16th it had diminished to light, with clear and cool weather, in marked contrast with the conditions of the previous day.

The streets were littered with limbs of trees, and the river front was strewn several feet deep with drift wood. Immense saw logs three feet in diameter had floated up the street to within a half block of the Government Building, or four and one-half blocks above the river front.

The damage within the city was slight. The Bay Shell Road a mile below the city from Frascati to Monroe Park, and points below, was washed away entirely. A number of small craft, mostly private sailing yachts, were lost. Bath houses along the eastern shore of Mobile Bay, and along the Gulf coast between Mobile and New Orleans, were washed away. Most of the damage reported from these districts was

due to the high tides. No loss of life is reported, and vessels coming in later, while damaged to some extent as to rigging and sail, rode safely through the storm.

The captain of the steamship *Espana* reports that he first encountered the storm in the Gulf Monday, August 12, at 2:30 p. m., with wind 20 to 30 miles, which gradually increased through Tuesday and Wednesday, until a maximum was reached Thursday between 2 and 7 p. m., the barometer falling steadily all the while. The wind was estimated to be between 60 and 70 miles an hour from the southeast. The Gulf was very rough, and waves broke over the funnels. Between the hours of 2 and 7 p. m., Thursday, there was so much spray that it was impossible to see where the boat was going. The captain and the entire crew had remained on watch for three days and nights, and were in an exhausted condition when they reached port Friday morning.

The secretary of the Chamber of Commerce informed me that the amount saved by the warnings could not be estimated, but would aggregate several millions of dollars.

Aside from advices issued in connection with the middle Gulf coast storm, no special forecasts or warnings were required in the United States; neither were hurricane warnings ordered, nor were they needed, in the West Indies.

The forecast center for the west Gulf district was closed at Galveston, Tex., August 5, and opened at New Orleans, La., August 8, 1901.

AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	1, a. m.	50	120	6, p. m.	46	60	3,300	5.5	600	25.0
II	6, a. m.	51	114	9, p. m.	41	70	2,425	3.5	693	28.9
III	9, p. m.	49	104	13, a. m.	48	53	2,750	3.5	786	32.7
	11, p. m.	45	67				825	1.5	550	22.9
IV	13, a. m.	53	121	19, p. m.	46	60	3,625	6.5	558	23.2
V	17, a. m.	53	121	22, p. m.	46	60	3,025	5.5	550	22.9
VI	22, p. m.	54	114	26, a. m.	42	76	2,300	3.5	657	27.3
VII	25, a. m.	50	100	28, p. m.	46	60	2,150	3.5	614	25.6
VIII	28, a. m.	51	114	31, p. m.	49	86	1,425	3.5	407	17.0
Sums							21,825	36.5	5,415	225.5
Mean of 9 paths							2,425		602	25.1
Mean of 36.5 days									598	24.9
Low areas.										
I	1, a. m.	44	104	3, a. m.	48	68	2,000	2.0	1,000	41.7
II	4, p. m.	51	114	7, a. m.	48	90	1,625	2.5	650	27.1
III	4, p. m.	32	100	7, p. m.	48	68	2,375	3.0	791	33.0
IV	7, a. m.	44	116	11, a. m.	45	64	2,700	4.0	675	28.2
V	9, a. m.	21	78	19, p. m.	42	83	2,275	10.5	217	9.0
VI	21, p. m.	35	98	24, a. m.	48	68	1,825	2.5	730	30.4
Sums							12,800	24.5	4,063	169.4
Mean of 6 paths							2,133		677	28.2
Mea of 24.5 days									522	21.8

For graphic presentation of these highs and lows see Charts I and II.—*Geo. E. Hunt, Chief Clerk Forecast Division.*

RIVERS AND FLOODS, AUGUST, 1901.

The Mississippi River mean stage was about 3.5 feet lower than during July, 1901, with the greatest fall below the mouth of the Ohio River. The fall was steady throughout the month above Cairo, Ill., but below that place it was interrupted about the middle of the month by heavy rains and for ten days thereafter there was a steady rise, the maximum stages occurring between the 27th and 31st. The maximum stage of 11.4 feet at New Orleans, La., on the 15th, however, was due neither to the rain nor to the rise from the upper river, but to backwater from the high Gulf tide that occurred during the tropical storm in progress at that time.

The Missouri and Ohio rivers presented nothing of special interest, and both were somewhat lower than during the preceding month.

In the Tennessee, Cumberland, and the rivers of the South Atlantic States, conditions were widely different, the heavy rains of the middle of the month causing flood stages generally, except along the Cumberland where the danger lines were hardly reached. In the Tennessee, danger line stages were general from Chattanooga to the mouth of the river. The following report on the general conditions of the Tennessee River for the month, from the head waters to Bridgeport, Ala., was prepared by Mr. L. M. Pindell, official in charge of the United States Weather Bureau office at Chattanooga, Tenn.

The month opened with the river below the safe navigable stage for large boats and with a continuation of the drought which had prevailed since June 8. On the 5th, light rain was reported over the river system with a slight rise at Clinton, Tenn., and a storm center over the lower Mississippi Valley which moved northeastward to north Georgia, producing heavy rains in front of its center ranging from 0.91 inch at Kingston, Tenn., to 3.24 inches at Rogersville, Tenn. The storm then moved northward along the Atlantic coast with heavy rain over the extreme headwaters. The French Broad and Holston rivers rose rapidly, producing a 10-foot rise at Knoxville, Tenn., by the morning of the 7th and opening navigation at Chattanooga, Tenn. The river then rose to 12.2 feet by 8 a. m. of the 9th and afterwards fell slowly. Light drift was general on the 8th, 9th, and 10th. Rain began on the 10th and continued on the 11th and 12th, but was not very heavy except at Riverton, Ala., where 1.68 inches fell in twenty-four hours ending 8 a. m. of the 11th. On the 13th heavy rain was reported over the Tennessee Valley, the headwaters, and in North Carolina, and continued on the 14th and 15th over the same sections, extending also into South Carolina, Georgia, and Virginia. This heavy rain very probably resulted from the influence of the storm which was centered over the Gulf and which moved northward, east of the Mississippi River from the 14th to 17th, accompanied by heavy rains. The tributaries rose rapidly after the 13th, and on the 15th a rise of 13 feet was reported at Clinton, with the river 1.7 feet above the danger line, 10.5 feet at Kingston, 6.5 feet at Knoxville, and 7.5 feet at Chattanooga. Clinton had a rise of 20.9 feet in forty-eight hours and Kingston 14 feet. On the 16th at 8 a. m. the river at Chattanooga stood at 27.3 feet, showing a rise of 13.3 feet in twenty-four hours.

All the tributaries, and the Tennessee, at Knoxville, were falling at 8 a. m of the 17th, but still rising slowly at Chattanooga. The water passed the danger line at Chattanooga at 11 a. m. and reached the crest of 33.8 feet between 11 p. m. and 12 m. The reports were all delayed on the 14th, but when received, the following flood warnings were sent to Knoxville and Kingston. To Knoxville: "Additional advices from headquarters indicate rapid rise in river, and it will reach 25 or more feet at Knoxville by Thursday noon." To Kingston: "Heavy rains over headwaters of Clinch; river will rise rapidly, reaching 20 or more feet by to-morrow night (15th); notify river interests." On the 15th when Clinton reported a 13-foot rise the following flood warning was sent to Kingston: "River at Kingston will reach 31 or 33 feet. Heavy rise and rainfall above you." On the 15th the conditions justified a prediction of from 38 to 40 feet at Chattanooga by Saturday morning, but on the afternoon of the 16th the crest was lowered to 36 feet by Saturday noon or evening. The river interests above this city had from thirty-six to forty-eight hours notice, and at and below this city from two to seven days warning. The lower river interests were kept posted by bulletins and telegrams as to the conditions and forecasts. The loss was not as heavy as anticipated owing to prompt measures taken. Considerable damage occurred on the Southern Railway near the Watauga River, also on other roads in that vicinity. The road beds were made soft by the continuous heavy rains and trains ran slow and cautiously. The river bottoms suffered the most; all crops being practically ruined. The drift was heavy from the 15th to the 17th, and consisted of live hogs, dead animals, small buildings, fences, trees, logs, etc. This rise in August was unprecedented, passes all recollection of the oldest inhabitants, and breaks all records as to tide in river and amount of rainfall. During this freshet the heaviest rainfall for the period and for twenty-four hours was at Clinton. From 8 a. m. August 10, to 8 a. m. August 18, or in eight days, the total amount of rainfall at each station in the Tennessee River system was as follows:

	Inches.
Asheville, N. C	3.61
Murphy, N. C	4.87
Bryson, N. C	6.98
Speers Ferry, Va	5.47
Tazewell, Tenn	8.07
Bluff City, Tenn	4.67
Greeneville, Tenn	4.58
Rogersville, Tenn	4.18
Clinton, Tenn	9.80

	Inches.
Knoxville, Tenn	6.95
Kingston, Tenn	8.85
Charleston, Tenn	4.37
Chattanooga, Tenn	5.92
Bridgeport, Ala.	9.90
Florence, Ala.	6.70
Riverton, Ala	7.96

Special 3 p.m. river observations were received from all the river stations, including Charleston, Tenn., on the 15th, 16th, and 17th.

It is estimated that $100,000 would hardly cover the damage to crops in the lowlands near the Tennessee River between Chattanooga and Florence; the farmers state that the crop left will not yield over an average of a quarter of a bale of cotton to the acre and about eight barrels of corn will be made. The river remained above the danger line two days at Bridgeport and seven days at Florence and Riverton, lasting until the 26th at Florence and one day later at Riverton.

Mr. J. D. Bladgen, Observer temporarily in charge of the United States Weather Bureau office at Cairo, Ill., made the following report on the high water in the lower Tennessee from Florence, Ala., to its mouth:

Heavy rains over the upper Tennessee watershed August 13, 14, 15, and 16 caused the river to rise. At Florence, Ala., the rise began on the 16th and at Johnsonville, Tenn., on the 17th.

The crest stage reached Florence at noon of the 22d and Johnsonville on the 27th. The danger line was exceeded at Florence by 3 feet, and at Johnsonville by 6.6 feet.

Warnings were telegraphed to Florence and Johnsonville on the 17th; on the receipt of the warnings at both places bulletins were posted and all interested were notified by telephone.

All movable property that would be damaged by the water was removed to a place of safety; consequently all the damage done was to growing crops in lowlands; all such crops were destroyed.

The predicted stage at Florence was 18 feet; the stage reached was 19 feet; at Johnsonville, predicted stage, 25 feet; stage reached, 27.6 feet.

Heavy rains occurred over the upper Tennessee watershed after the warnings were sent out, and it is probably from this cause that a higher stage was reached than was at first anticipated.

The floods in the James, Roanoke, and Cape Fear rivers did not assume extensive proportions, although at some places they neared or somewhat exceeded the danger lines. Local warnings were issued for all three rivers, and portable property, liable to damage by overflow, removed to places of safety. Some slight damage was done to growing crops in the bottom lands.

Concerning the floods in the rivers of South Carolina, Mr. L. N. Jesunofsky, official in charge of the United States Weather Bureau office at Charleston, S. C., reported as follows:

There were three distinct flood periods within the streams of South Carolina during August, 1901, as follows: 7th to 10th, 15th to 20th, and 24th to 30th. Excessive rainfall of 3.50 to 4.50 inches over the catchment basins of the Wateree, Pedee, and Congaree rivers on the 5th and 6th, produced exceedingly rapid stream-flows at Camden, Cheraw, and Columbia on the 7th and 8th. At Camden, the danger line was reached during the early morning of the 7th, the highest gage reading attained, 30.2 feet, or 5.2 feet above danger line, being at the 8 a. m. observation of the 8th. The stream at Cheraw rose 27 feet during the night of the 6th and morning of the 7th. By the morning of the 9th it had reached a gage reading of 36.2 feet, or 9.2 feet above the danger line. The Congaree, at Columbia, rose 10.2 feet during the 7th and 8th, without reaching the danger line, and began to rapidly recede on the 9th.

The central Gulf hurricane of the 13-16th produced heavy precipitation of 4 to 6.50 inches over the northwestern section of this State, and the western and central portions of North Carolina, causing rises of 13.2 feet at Camden, 21.1 feet at Cheraw, and 10.1 feet at Columbia during the 14th, 15th, and 16th, the gage heights averaging 2 feet above the danger lines on the 16th, 17th, and 18th at the places mentioned.

Frequent, and at times heavy, local rains during the last decade in the extreme upper sections of this State and western North Carolina elevated the streams 8.1 feet at Camden on the 24th and 25th, and 5.9 feet at Cheraw and Columbia on the 28th and 29th. The Wateree, at Camden, remained at and slightly above the danger line on the 24th, 25th, and 26th. The Congaree reached the danger line on the 29th, after which it began to rapidly recede. The freshets on the upper Pedee of the 7th, 8th, and 9th, and the 14th, 15th, and 16th produced one general flood only upon the lower Pedee at Smith's Mills, from the 15th to the 28th, when the stream heights, at the latter point, varied from the danger line, 16 feet, to 17.6 feet, or 1.6 feet above the danger line. Almost the same conditions were observed upon the Santee as upon the lower Pedee. The flood waters upon the Wateree and Congaree of the 6th to 18th reached the lower Santee at St. Stephens at 8 a. m., of the 23d, when the gage registered 12 feet, the point of danger, and remained at that point until 8 a. m., of the 28th. The streams were above the danger lines on the following dates: At Camden from the 7th to the 9th, 15th to 20th, and 24th to 26th. At Cheraw from the 7th to the 10th, and 15th to 18th. At Columbia from the 16th to the 19th, and on the 29th. At Smith's Mills from the 14th to the 29th, and at St. Stephens from the 24th to the 28th. There is no record of three floods having occurred in the streams of South Carolina, previously, during any single month since the establishment of the South Carolina river service in 1891. Timely warnings of the Wateree, Pedee, and Congaree floods were telegraphed from this office.

There was very much delay in the harvesting of rice on the lower Black, lower Pedee, lower Waccamaw, and lower Santee rivers during the entire month, on account of the freshet water being elevated higher than that in the submerged rice fields, and preventing the drainage of the fields themselves. In many cases rice was entirely spoiled for the want of dry fields in which to cut and stack it. Considerable delay upon the construction of the lock and dam at Granby, S. C., on the Congaree, 12 miles below Columbia, S. C., under the supervision of the U. S. Engineer Corps, was experienced throughout the month, owing to the numerous freshets. Heavy rains of the 14th, 15th, and 16th caused several washouts upon the railways in Greenville and Spartanburg counties, S. C., and in Hudson and Polk counties, N. C., delaying travel for one day. Several toll bridges, wooden structures, leading over Lynch River, in Florence County, S. C., were either washed away or loosened from their fastenings by the recent floods. Florence County has had very heavy expense this year in repairing bridges, roads, and causeways damaged by floods. Several of the bridges endangered are the most important in the county, since they are the most frequently used by citizens in going to and from the Court House at Florence.

Along the Coosa and Alabama rivers and their tributaries the stages reached were not unusual, yet, owing to their occurrence at a critical time when there was great danger to all crops in the lowlands, much unavoidable loss and damage occurred. All property, however, that could be carried to higher ground was saved through the very accurate and timely warnings that were issued by the Weather Bureau. The following description of this flood was prepared by Mr. I. G. Gardiner, Observer temporarily in charge of the United States Weather Bureau office at Montgomery, Ala.

The morning report of the 16th showed heavy rainfalls over the entire watershed, averaging considerably over an inch at Canton, Resaca, Rome, and Tallassee, and over two and one-half inches at Gadsden, Wetumpka, and Montgomery, with rain still falling at all Georgia stations. Warnings were immediately issued for rapid, but not dangerous rises, and a 20-foot stage was forecast for Montgomery; at the same time special 2 p. m. reports were called for. The latter showed a cessation of rainfall indicating no necessity for a special bulletin at that time. On the morning of the 17th Canton reported a fall of nearly one foot; other stations a rise of two to five feet. Additional rains occurred quite generally on the 17th and 18th, and on the morning of the 19th, with a secondary rise coming in the Etowah at Canton, warnings were issued to all interested points, and the danger line stage was forecast for Gadsden. The rainfall was very light on the morning of the 20th, and a fall of nearly two feet was reported in the Etowah; still, considering the volume of water then in the rivers, the danger line stage at Gadsden was adhered to, and the expected stage at Montgomery raised to slightly above 20 feet. On the morning of the 21st reports showed quite general though moderate rains, with another secondary rise of 2 feet at Canton, at which point it was still raining, and the previously estimated stages at Gadsden and Montgomery, danger line and slightly above 20 feet, respectively, were expected to be exceeded, and forecasts so made and disseminated. Additional heavy rains of about one and one-half inches occurred at Georgia stations on the 21st, and upon receipt of this information in the morning reports of the 22d a forecast of a 22-foot stage at Montgomery was made, wide dissemination of this information made, and farmers were notified to take every precautionary measure. Special reports at 2 p. m. warranted this office in raising the forecast stage at Montgomery to 23 feet, and the public was so advised; at the same time Lincoln, Ala., was advised of flood stages for that place during the succeeding two or three days. The rivers rose steadily and attained the following reported stages: Gadsden, 20 feet; Wetumpka, 26 feet; Montgomery, 23 feet.

In view of the prolonged and intermittent rainfall and the perplexing secondary rises setting in at critical stages lower down the river, it is thought that a more perfect forecast could not possibly have been made. Probably at no time in the previous history of the river service in this section was more perishable property jeopardized, and though the stages attained in the rivers were not very high, still the unavoidable damage to lowland crops was very heavy. When due considera-

tion is given to the very large area of river lowlands in corn and other crops, there is no exaggeration in placing the value of the property jeopardized at $1,000,000. Numerous calls were made upon the local office, and our suggestions were closely followed. In one instance a farmer had embankments thrown up to guard against our 20-foot stage forecast for Montgomery, and thus saved about 75 acres of corn, only to lose about 1,000 bushels later by the 23-foot stage, which, although predicted several days in advance, could not be guarded against. In another instance a farmer lost about $1,000 worth of truck, this damage, also, being unavoidable. In other cases, where lowland corn was sufficiently matured for forage, many acres devoted to this grain were cut and saved. At least $25,000 damage was done by this freshet, which no warnings could have averted.

The local press was most accommodating in disseminating the information, and warmly complimented the Bureau upon the timeliness and value of the warnings.

The stages in the Black Warrior and lower Tombigbee rivers, while not quite reaching the danger lines, were, nevertheless, sufficiently high to excite some apprehension in the minds of the farmers and planters along their banks, and, on the 17th, they were advised to remove stock and portable property to higher ground.

Nothing of special interest was reported from the rivers of the Pacific coast system. They continued their steady fall throughout the month.

The highest and lowest water, mean stage, and monthly range at 134 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are: Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport on the Red.—*H. C. Frankenfield, Forecast Official.*

CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following summaries relating to the general weather and crop conditions are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau.

[Temperature is expressed in degrees Fahrenheit and precipitation in inches and hundredths.]

Alabama.—The mean temperature was 78.6°, or 1.0° below normal; the highest was 104°, at Decatur and Madison on the 3d, and the lowest, 54°, at Maple Grove and Scottsboro on the 1st. The average precipitation was 8.86, or 3.42 above normal; the greatest monthly amount, 16.75, occurred at Daphne, and the least, 3.30, at Evergreen.

The general rain period from the 11th to the 23d was very injurious to corn and cotton, particularly the excessive rainfalls on the 15–16th; streams overflowed and inundated large areas of lowlands, doing great and in many cases irreparable damage to corn and fodder, while the continuance of wet weather wrought much damage to cotton.—*I. G. Gardiner.*

Arizona.—The mean temperature was 82.8°, or 0.2° above normal; the highest was 119°, at Fort Mohave on the 28th, and the lowest, 44°, at Taylor on the 20th and at Flagstaff on the 21st. The average precipitation was 1.82, or 0.55 below normal; the greatest monthly amount, 7.97, occurred at Nogales, while none fell at Gila Bend and Sentinel.

Weather conditions throughout the month have been very favorable to plant growth and crop development. The ground having been thoroughly soaked from the rains that occurred from the 1st to the 18th of the month, together with canals running full, the outlook in the irrigated districts for good fall crops is very promising. In the lower valley of the Colorado citrus trees are heavily fruited and are of thrifty appearance. The range is in excellent condition.—*L. M. Dey, Jr.*

Arkansas.—The mean temperature was 80.5°, or 1.5° above normal; the highest was 109°, at Jonesboro and Newport on the 3d, and the lowest, 52°, at Arkadelphia on the 7th and at Pond on the 23d. The average precipitation was 2.95, or 0.25 below normal; the greatest monthly amount, 3.05, occurred at Lutherville, and the least, 0.58, at Fort Smith.

Temperatures were high and the rainfall was very unevenly distributed during the first week of the month. Cotton improved in most sections, but was small and was shedding badly in some localities. Early corn was a decided failure, but the late planted showed some slight improvement. The second and third weeks the weather was characterized by temperatures about normal and rain in most sections, but unevenly distributed. Cotton was fair to good in most sections, but continued to shed and was being further damaged by rust. Late corn improved generally. During the closing days of the month higher temperatures prevailed and the rainfall, while heavy in some localities, was below the normal and was unevenly distributed. Cotton continued in fair to good condition, but it was still shedding and being damaged by rust; it had begun to open prematurely during the last decade of the month and picking had commenced, but was not general. Early corn had proved a complete failure and had been cut for fodder; late planted showed some little improvement. Late planted potatoes did not do well on account of lack of moisture. Fruits generally were a failure in most sections, while in others peaches and apples were abundant, but the quality was poor.—*E. B. Richards.*

California.—The mean temperature was 75.6°, or about normal; the highest was 124°, at Salton on the 26th, and the lowest, 24°, at Bodie on the 21st. The average precipitation was 0.12, or 0.05 above normal; the greatest monthly amount, 2.50, occurred at Mammoth Tank, while none fell at about half of the stations.

Favorable weather prevailed during the month, and crops matured rapidly. In some localities, however, the comparatively low temperature retarded the development of grapes and late deciduous fruits. Heavy crops of wheat and barley have been harvested and mostly thrashed. The labor troubles are seriously interfering with shipments of grain and fruit.—*G. H. Willson.*

Colorado.—The mean temperature was 68.2°, or 1.4° above normal; the highest was 105°, at Delta on the 2d, and the lowest, 30°, at Wagon Wheel Gap on the 13th and at Breckenridge on the 21st. The average precipitation was 2.29, or 0.75 above normal; the greatest monthly amount, 6.53, occurred at Yuma, and the least, 0.36, at Marshall Pass.

One of the wettest Augusts in thirteen years. Precipitation came too late to save a large acreage of upland field crops, but was of material benefit to late corn, potatoes, and the third crop of alfalfa. Ranges also made marked improvement and at the close of the month were generally green—an unfortunate condition unless warm, dry weather should prevail during September.—*F. H. Brandenburg.*

Cuba.—The mean temperature was 81.2°; the highest was 97°, at Batabano, Holguin, and Los Canos (Guantanamo), and the lowest, 60°, at Santa Clara. The average precipitation was 5.13; the greatest monthly amount, 11.54, occurred at Pinar del Rio, and the least, 0.87, at Holguin.

Rains were very heavy in eastern and southern Pinar del Rio, and light in northern Santiago de Cuba; elsewhere they were fairly uniform and seasonal. The temperature changes were slight; the average temperature was about normal. Cane made good growth, but in some localities received too much moisture. The frequent showers interfered with field work. In Pinar del Rio sowing of tobacco seed beds was impeded by heavy rains; in other tobacco sections fair progress was made with beds and preparation of tobacco land. Small crops suffered somewhat from excessive moisture, but in most districts they made good advancement.—*W. B. Stockman.*

Florida.—The mean temperature was 80.4°, or 1.0° below normal; the highest was 99°, at Middleburg on the 1st, Micanopy on the 29th, and Middleburg on the 31st, and the lowest, 64°, at DeFuniak Springs and Marianna on the 4th. The average precipitation was 10.58, or 3.09 above normal; the greatest monthly amount, 19.75, occurred at Earnestville, and the least, 4.01, at St. Augustine.

Although precipitation averaged decidedly above the normal, the distribution was far from satisfactory. It was somewhat local, as evidenced by the wide range in monthly totals. The month was generally favorable for corn, but cotton had many setbacks. Excessive rains caused rust and shedding and at the end of the month picking was retarded by frequent showers. Cane, cassava, citrus fruits, sweet potatoes, and minor crops did very well. During the latter part of the month there was much activity in preparing lands for fall vegetables. Some tomatoes and irish potatoes were planted; strawberry plants pushed forward, and much work was accomplished setting pineapple slips. The tropical storm which moved inland near the middle gulf caused considerable damage to cotton and corn, as a result of high winds and heavy rains.—*A. J. Mitchell.*

Georgia.—The mean temperature was 78.2°, or 1.1° below normal; the highest was 98°, at Allentown and Lumpkin on the 10th, and the lowest, 55°, at Clayton on the 1st, and at Diamond and Ramsey on the 2d. The average precipitation was 9.92, or 4.28 above normal; the greatest monthly amount, 22.07, occurred at Clayton, and the least, 3.22, at Camak.

The month was remarkable for the large amount of rainfall, which exceeded 15 inches at numerous stations in the northern portion of the State. With one exception, it was the wettest August in the past ten years, the average number of days with rain being 18. The thermal element was slightly below normal and without special feature. The minor crops of the State suffered little damage from the prevailing conditions, but the staple product, cotton, received a serious setback at a critical period of its life. Lowlands were flooded by the excessive rains, and some bottom crops were destroyed—*J. B. Marbury.*

Idaho.—The mean temperature was 69.4°, or 3.1° above normal; the highest was 108°, at Garnet on the 13th, and the lowest, 29°, at Swan Valley on the 28th. The average precipitation was 0.53, or 0.11 below normal; the greatest monthly amount, 2.29, occurred at Swan Valley, while none fell at Garnet.

The month was deficient in precipitation in all parts of the State except near the eastern boundary, where there was an excess. The Boise River is dry for several miles in Canyon County, owing to excessive use of water in canals farther up the stream.—*E. L. Wells.*

Illinois.—The mean temperature was 74.7°, or 0.4° above normal; the highest was 108°, at Centralia on the 2d, and the lowest, 41°, at Lanark on the 4th and 25th. The average precipitation was 1.76, or 1.09 below normal; the greatest monthly amount, 5.96, occurred at Cobden, and the least, 0.05, at Zion.

Temperature conditions have generally been favorable for crops. Good showers occurred during the month over most of the State, and considerable improvement in crop conditions has resulted. In some sections the weather has continued dry, and crops have continued to deteriorate slightly.—*M. E. Blystone.*

Indiana.—The mean temperature was 75.0°, or 1.1° above normal; the highest was 103°, at Prairie Creek on the 2d and 9th, and the lowest, 44°, at Topeka on the 11th. The average precipitation was 3.06 or 0.02 below normal; the greatest monthly amount, 7.77, occurred at Seymour, and the least, 0.86, at Prairie Creek.

The abnormally high temperature and general drought that began in July, with correspondingly deleterious effects upon all vegetation, continued until about the middle of August. Much early-planted corn, corn on hill lands, and garden truck had been damaged beyond recovery; stock water and pastures had failed until watering from domestic wells and feeding was necessary in many localities. During the last half of August weather conditions were more favorable, and all crops not completely ruined took on new vigor and made rapid growth.—*W. T. Blythe.*

Iowa.—The mean temperature was 73.8°, or 2.7° above normal; the highest was 105°, at Pacific Junction on the 1st, and the lowest, 40°, at Forest City on the 10th and Washington on the 31st. The average precipitation was 1.29, or 1.78 below normal; the greatest monthly amount, 4.46, occurred at Sioux Center, and the least, trace, at Danville and Emerson.

The excess of temperature and sunshine and continued droughty conditions were quite unfavorable to pastures, potatoes, and late-growing vegetables. The corn crop made steady gains throughout the month in three-fourths of the State, giving promise of a much better yield than was deemed possible at the beginning of the month. Early corn was very near maturity and cutting was in progress at the end of the month; late-planted fields were making excellent progress. The soil was generally too dry for plowing and fall seeding.—*John R. Sage.*

Kansas.—The mean temperature was 79.1°, or 2.8° above normal; the highest was 110°, at Ness City on the 3d, and the lowest, 49°, at Jetmore on the 8th. The average precipitation was 2.61, or 0.07 below normal; the greatest monthly amount, 5 67, occurred at Hays, and the least, 0.71, at Dodge and Norwich.

There was a much better distribution of rain through the month than in July, materially improving condition of crops. Late corn, forage, pastures, peaches, and winter apples continued to improve, but the great heat of the 25th injured the corn in many eastern counties and cutting began. Plowing progressed favorably during most of the month, but the ground became too dry over a large part of the State by the last week.—*T. B. Jennings.*

Kentucky.—The mean temperature was 75.5°, or 1.1° below normal; the highest was 101, at Bowling Green on the 3d, and the lowest, 50°, at Anchorage on the 5th. The average precipitation was 5.12, or 1.67 above normal; the greatest monthly amount, 15.50, occurred at Alpha, and the least, 1.42, at Owenton.

The weather was quite favorable for all crops during the month. The temperature averaged about normal, and the rainfall was a little above normal. The drought which prevailed during the latter part of July was broken and all crops improved rapidly. The greatest improvement was in tobacco and late corn.—*H. B. Hersey.*

Louisiana.—The mean temperature was 81.9°, or 0.7° above normal; the highest was 105°, at Minden on the 17th, and the lowest, 52°, at Robeline on the 29th. The average precipitation was 5.46, or 0.47 above normal; the greatest monthly amount, 14.74, occurred at Port Eads, and the least, 1.86, at Minden.

The severe windstorm which passed over the southeastern portion of the State during the second decade of the month damaged rice. As a rule, however, the crop was doing well at the close of the month. Early rice was maturing, and harvest had commenced. Sugar cane made good growth. Cotton was damaged some by dry weather, rust, and lice; shedding was complained of from nearly all portions of the State; picking had commenced, but was not general at the close of the month; preparations for fall gardens well advanced.—*I. M. Cline.*

Maryland and Delaware.—The mean temperature was 75.0°, or 0.7° above normal; the highest was 98°, at Sharpsburg, Md., on the 21st and at Denton, Md., on the 23d, and the lowest, 42°, at Sunnyside, Md., on the 11th. The average precipitation was 5.85, or 2.17 above normal; the greatest monthly amount, 12.05, occurred at Princess Anne, Md., and the least, 2.70, at Coleman, Md.

During August the rainfall was in excess in all parts of the section, with the exception of quite limited areas. There were no very cool spells or hot waves, although the temperatures were generally above normal from the middle of the month until near its close, and the entire period was a trifle warmer than usual. The weather conditions were favorable for corn, buckwheat, pastures, young grasses, the late hay harvest, and many kinds of truck growth, but were not suitable for the thrashing of grain, for potatoes, tomatoes, melons, and the curing of tobacco. Corn will be a fine crop; some fodder saving was done at the close of the month. The corn ground is very grassy, and the farmers will have difficulty in preparing it for wheat seeding. Fallow land has broken nicely, and preparation for fall seeding has made satisfactory advance. Peaches have been yielding poor to fair, according to locality; apples will be scarce. Caterpillars appeared in enormous numbers late in the month, attacking the foliage of forest as well as fruit trees.—*E. C. Easton.*

Michigan.—The mean temperature was 67.9°, or 0.3° above normal; the highest was 96°, at Grape on the 9th and Stanton on the 15th, and the lowest, 29°, at Thomaston on the 31st. The average precipitation was 2.52, or 0.10 below normal; the greatest monthly amount, 6.46, occurred at Mackinaw City, and the least, 0.42, at Grand Haven.

The month, as a whole, has been favorable, and with the exception of a small area in southwestern Michigan all crops have made good progress during the month. The first half of the month was quite dry and slightly delayed fall plowing; the rains which fell after the 17th greatly revived pasturage and improved the soil for plowing. At the close of the month all outstanding crops, principally corn, late potatoes, sugar beets, and beans, were in promising condition.—*C. F. Schneider.*

Minnesota.—The mean temperature was 69.8°, or 2.0° above normal; the highest was 105°, at Lake Jennie on the 17th, and the lowest, 32°, at Tower on the 31st. The average precipitation was 2.21, or 1.25 below normal; the greatest monthly amount, 4.65, occurred at Thief River Falls, and the least, 0.68, at New London.

The month was moderately warm, with high temperatures in southwestern portions on the 1st, and generally on the 16th, 17th, 18th, 20th, and 21st. There was a general rain on the 8th with temporary benefit, and more or less scattered showers on the 12th, 13th, 21st, and 24th, and more widely scattered showers on other dates. Some of these were locally heavy. Where the rains were heaviest there was improvement in late corn, late potatoes, pastures, and gardens, and better conditions for plowing. The harvesting of the small grains was finished in the southern half of the State by the 5th. Wheat and oat cutting began in Kittson County on the 1st, but late wheat was still heading in northern counties early in the month. Harvesting progressed steadily, till by the end of the month only the late grain in the extreme north was uncut. Stacking and thrashing followed harvest as rapidly as possible. Corn was seriously injured by the drought, and where it was evident that there would be no grain, it was cut for fodder early in the month, and this fodder cutting has continued during the month. The corn crop is very irregular. Flax is very poor in northern portions, but somewhat better farther south; its cutting and thrashing has been going on all the month. Potatoes are poor in southern fields, but better in those of the north. Plowing has been going on, but generally the work was hard and unsatisfactory. Pastures have suffered severely by the drought, and many cattle have had to be fed. A large wild hay crop was saved during the month.—*T. S. Outram.*

Mississippi.—The mean temperature was 80.0°, or about normal; the highest was 105°, at Batesville, Kosciusko, and Water Valley on the 3d, and the lowest, 55°, at Aberdeen on the 2d. The average precipitation was 7.00, or 2.30 above normal; the greatest monthly amount, 14.13, occurred at Louisville, and the least, 0.86, at Nittayuma.

The first half of the month was dry, and temperatures ranged from 2° to 4° above normal. A heavy and general rain fell about the middle of the month, and another light one about the 27th. Cotton was beginning to open at the first of the month, and before the close was being picked generally. Until the 15th the crop did fairly well, especially in the southern part of the State; although there were some complaints of its blooming at the top and being injured otherwise by the continuous drought. The heavy rains of the 14-17th damaged it by causing it to shed and to rot badly, especially in lowlands. However, it improved some during the last week. Early corn was damaged by drought beyond help; but young corn continued to do fairly well, and, although a large amount of it was blown down by heavy winds, before the close of the month it improved materially, and promised a better crop than was at first anticipated. Minor crops did well during the whole month.—*W. S. Belden.*

Missouri.—The mean temperature was 78.4°, or 2.3° above normal;

the highest was 109°, at Jefferson City on the 2d and Poplar Bluff on the 3d, and the lowest, 47°, at Bethany on the 31st. The average precipitation was 1.89, or 1.21 below normal; the greatest monthly amount, 6.98, occurred at Sikeston, and the least, 0.12, at Desoto.

Over a few of the extreme southeastern counties the precipitation of the month ranged from 4 to over 6 inches, being considerably in excess of the normal at a few stations, but over much the greater portion of the State it was deficient, a number of the extreme northeastern counties receiving less than 10 per cent of the normal amount. At Keokuk, Iowa, where the observations cover a period of thirty-one years, it was the driest August on record, and at Shelbina it was the driest since 1881, the total rainfall for the month at those stations being only .15 inch. During the early part of the month there was a marked improvement in the condition of late corn in the central and western sections, but during the latter half the weather was generally dry, and the crop again suffered a decline. In most sections pastures continued practically bare and much feeding of stock was necessary. Much blue grass, timothy, and clover was entirely killed by the drought.—*A. E. Hackett.*

Montana.—The mean temperature was 67.1°, or 1.7° above normal; the highest was 104°, at Glendive on the 16th, and the lowest, 25°, at Missoula on the 19th. The average precipitation was 0.52, or 0.17 below normal; the greatest monthly amount, 1.66, occurred at Glenwood, while none fell at Corvallis and Deer Lodge.—*E. J. Glass.*

Nebraska.—The mean temperature was 75.2°, or 2.2° above normal; the highest was 108°, at Agee on the 1st and at Fairbury on the 25th, and the lowest, 41°, at Ansley on the 3d and at Franklin on the 5th. The average precipitation was 2.25, or 0.36 below normal; the greatest monthly amount, 7.19, occurred at Wauneta, and the least, 0.49, at Albion.

The rains of the month improved late corn and pastures. Much early corn was cut for fodder. Considerable plowing has been done preparatory to sowing winter wheat, but little has been sown.—*G. A. Loveland.*

Nevada.—The mean temperature was 67.9°, or 1.2° below normal; the highest was 101°, at Mill City on the 1st and at Beowawe on the 13th, and the lowest, 29°, at Elko on the 29th. The average precipitation was 2.03, or 1.58 above normal; the greatest monthly amount, 7.79, occurred at Palmetto, while none fell at Wells.

During the early part of the month the weather was hot and sultry, and up to the 20th the temperature averaged slightly above normal; the latter part of the month was decidedly cooler, the temperature being well below normal. Heavy rains were general and well distributed throughout the State, with frequent cloud-bursts early in the month. Hay and grain harvests were in progress throughout the month, and all crops yielded above the average.—*W. W. Thomas.*

New England.—The mean temperature was 68.8°, or 1.7° above normal; the highest was 92°, at Provincetown, Mass., on the 12th and 18th, Norwalk, Conn., on the 21st, and the lowest, 34°, at Woodstock, Vt., on the 17th and 28th. The average precipitation was 4.44, or 1.66 above normal; the greatest monthly amount, 9.37, occurred at Waterbury, Conn., and the least, 1.08, at Durham, N. H.

The temperature and precipitation have averaged somewhat above the normal, but without marked extremes. Some damage was caused by local thunderstorms in parts of the section, but no general or severe storms occurred. The weather conditions were generally favorable for crops, particularly for grass and corn, which are exceptionally good. Potatoes have done poorly in nearly all parts of the section. Apples are a light crop and of poor quality; peaches and other fruits are a fair to good crop and of average quality. Tobacco, which was retarded in the early part of the season by unfavorable weather, has made up a good portion of the delayed growth and now promises a good crop.—*T. L. Bridges.*

New Jersey.—The mean temperature was 73.8°, or 1.3° above normal; the highest was 98°, at Vineland on the 10th, and the lowest, 44°, at Charlotteburg on the 2d and 3d. The average precipitation was 9.43, or 5.22 above normal; the greatest monthly amount, 15.62, occurred at Clayton, and the least, 4.88, at Oceanic.

The abnormally heavy rain on the 24th did considerable damage to crops by washing and flooding the lowlands, the valley of the Passaic suffering the greatest damage, where ten thousand acres were submerged and crops almost completely destroyed. The total rainfall for the month is the greatest recorded since the establishment of this service.—*E. W. McGann.*

New Mexico.—The mean temperature was 73.8°, or 1.5° above normal; the highest was 105°, at San Marcial on the 6th, and the lowest, 45°, at Fort Union on the 28th. The average precipitation was 2.37, or 0.16 above normal; the greatest monthly amount, 7.45, occurred at Las Vegas Hotsprings, and the least, 0.01, at San Marcial.

Feed and water on the stock ranges more abundant than usual, and all crops maturing well.—*R. M. Hardinge.*

New York.—The mean temperature was 69.0°, or 1.5° above normal; the highest was 93°, at Oneonta on the 21st, and the lowest, 35°, at Axton on the 5th and at North Lake on the 6th. The average precipitation was 5.11, or 1.52 above normal; the greatest monthly amount, 15.36, occurred at Bedford, and the least, 0.94, at Lyndonville.

The temperature and precipitation were generally favorable. Crops continued to make good growth, with prospects for fine corn and buckwheat crops, a good yield of late potatoes, excellent pastures, favorable outlook for fall feed, a fairly good crop of beans, and plenty of peaches and grapes, but very light apple crop, this fruit being almost a failure in New York State. Oats yielded light, and the wheat crop was largely destroyed earlier in the season by the hessian fly. Hops, sugar beets, and tobacco did well. Plowing for wheat and rye was well advanced during the latter part of the month, and thrashing was progressing.—*R. G. Allen.*

North Carolina.—The mean temperature was 76.5°, or 0.5° above normal; the highest was 99°, at Washington on the 9th, and the lowest, 46°, at Linville on the 8th. The average precipitation was 12.18, or 6.38 above normal; the greatest monthly amount, 30.74, occurred at Highlands, and the least, 3.87, at Hatteras.

Most crops improved somewhat during the first decade of August, especially cotton, late corn, and minor crops, such as sweet potatoes, peanuts, rice, and field peas. The weather from the 11th to the close of the month was extremely unfavorable, on account of the heavy and continuous rains, which washed lands badly, caused freshets, and the flooding of low lands, and prevented farmers from carrying on even the most necessary work. The average rainfall, 12.18 inches, is the largest on record since 1872; the total monthly rainfall exceeded 20 inches at seven stations, and over 30 inches was recorded at two points in the mountain region. Cotton suffered materially from excessive rainfall; shedding and rust prevailed almost everywhere toward the end of the month; plants are small, with inferior bolls and short lint; picking began during the last decade. Fall plowing progressed very slowly. All kinds of fruit are inferior.—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 66.9°, or 1.4° above normal; the highest was 100°, at Ellendale on the 20th and at Medora on the 26th, and the lowest, 32°, at Larimore on the 8th. The average precipitation was 1.77, or 0.07 above normal; the greatest monthly amount, 4.75, occurred at Grafton, and the least, 0.15, at Berthold Agency.

The weather was generally favorable for maturing and harvesting crops, only slight interruptions being caused by rain at intervals. No severe storms occurred, and while the northern portion was visited by frost, it was not heavy enough to do any damage.—*B. H. Bronson.*

Ohio.—The mean temperature was 73.1°, or 1.7° above normal; the highest was 101°, at Jacksonboro on the 8th, and Bethany and Camp Dennison on the 9th, and the lowest, 42°, at Orangeville on the 13th. The average precipitation was 3.32, or 0.38 above normal; the greatest monthly amount, 9.06, occurred at Warsaw, and the least, 0.83, at Plattsburg.

Cooler during first half of month. Drought continued until 14th. Corn, potatoes, tobacco, and gardens injured. Rains were frequent during last half of month. All late crops much improved, especially late corn, tobacco, and potatoes. Much plowing done.—*B. L. Waldron.*

Oklahoma and Indian Territories.—The mean temperature was 82.2°, or 1.4° above normal; the highest was 112°, at Waukomis, Okla., on the 26th and at Taloga, Okla., on the 26th and 27th, and the lowest, 44°, at Kenton, Okla., on the 19th. The average precipitation was 1.55, or 1.23 below normal; the greatest monthly amount, 3.89, occurred at Fairland, Ind. T., and the least, 0.18, at Holdenville, Ind. T.

Generally fair weather, with high maximum temperatures, becoming excessive toward the close, prevailed during the month. Light to moderate showers fell during the first half of the month, and very light showers during the last half. Cotton suffered considerable damage from premature opening, shedding, and other causes. The crop was opening fast and picking was in progress. Pastures were poor, stock water was scarce, and stock was not doing well.—*Charles M. Strong.*

Oregon.—The mean temperature was 68.9°, or 2.3° above normal; the highest was 110°, at Junction City on the 4th, and the lowest, 33°, at Beulah on the 27th. The average precipitation was 0.35, or 0.31 below normal; the greatest monthly amount, 3.00, occurred at Hare, while none fell at Brownsville.

The weather was favorable for harvesting the grain crops, but fruit and vegetables suffered from the drought, which was partially relieved by light showers during the last week of the month. The wheat yields were good and the quality excellent.—*Edward A. Beals.*

Pennsylvania.—The mean temperature was 72.0°, or 2.1° above normal; the highest was 99°, at Hawthorne, on the 12th, and the lowest, 42°, at Saegerstown, on the 5th. The average precipitation was 6.81, or 2.64 above normal; the greatest monthly amount, 13.65, occurred at Hamburg, and the least, 2.48, at Lock No. 4.

The weather for the month was favorable for the growth and maturing of crops and general farm work. Showers were frequent, plentiful, and fairly well distributed. The total rainfall was heaviest in the central-eastern portion of the State, and least in the southwestern portion and the Cumberland Valley. Washouts and hail did some damage to crops, but in the aggregate the losses were unimportant. No damaging frosts occurred. At the close of the month, growing crops were well advanced and doing well, and the harvested ones had been secured in good condition. The preparation of ground for fall seeding was well advanced and some seeding had been done.—*T. F. Townsend.*

Porto Rico.—The mean temperature was 80.6°; the highest was 97°,

at Manati, Cayey, Ponce, and Bayamon, on different dates, and the lowest, 63°, at Hacienda Amistad on the 5th. The average precipitation was 6.42; the greatest monthly amount, 16.70, occurred at Las Marias, and the least, 2.47 at Ponce.—*E. C. Thompson.*

South Carolina.—The mean temperature was 78.6°, or about normal; the highest was 97°, at Allendale on the 1st, and at Greenwood on the 11th, and the lowest, 57°, at Clemson College on the 15th and at Liberty on the 28th. The average precipitation was 9.01, or 2.70 above normal; the greatest monthly amount, 19.32, occurred at Liberty, and the least, 3.23, at Beaufort.

The temperature was equable throughout the month, and favorable to crops. Excessive precipitation over the western half of the State caused some physical injury to lands, floods in the streams, and much damage to crops on bottom lands. Cotton improved on clay lands, where it grew rapidly and fruited well, but reached maturity on sandy lands. Late corn, peas, and sweet potatoes did well. Forage crops grew luxuriantly. A general improvement in all growing crops was noted.—*J. W. Bauer.*

South Dakota.—The mean temperature was 72.3°, or 1.0° above normal; the highest was 112°, at Forestburg on the 1st, and the lowest, 37°, at Rochford on the 11th. The average precipitation was 2.52, or 0.33 above normal; the greatest monthly amount, 4.86, occurred at Armour, and the least, 0.30, at Oelrichs.

Very high temperature prevailed over the eastern portion of the State on the 1st, the former extreme maximum temperature at Huron being exceeded by 0.5°. Harvesting of spring wheat, oats, barley, rye, and spelt was practically completed during the first decade, these crops were secured under favorable weather conditions, and generally the weather was favorable for stacking, thrashing, haying, and the healthy advancement of corn, potatoes, flax, and millet. Timely rains kept pastures and range grass in favorable condition. The improvement in corn, especially the late planted, was greater than was thought possible after the damaging heat of July. Damaging hailstorms occurred in the vicinity of Wolsey, Beadle County, and Flandreau, Moody County, at the latter point 2.06 inches of precipitation occurring within an hour. At the end of the month, considerable early corn was ripe and ripening, and cutting was in progress, and considerable late corn was safe from frost, with conditions indicating that with favorable weather the bulk of the corn crop would be safe by September 10th to 15th.—*S. W. Glenn.*

Tennessee.—The mean temperature was 75.5°, or 0.4° below normal; the highest was 104°, at Iron City and Pope on the 3d, and the lowest, 45°, at Erasmus on the 2d. The average precipitation was 9.75, or 5.92 above normal; the greatest monthly amount, 16.72, occurred at Decatur, and the least, 3.10, at Union City.

Drought was still prevailing at the beginning of the month, but good rains fell on the 5th and 6th, and on the 10th a remarkable period of rainy weather began and continued, with daily record until the 24th, when there was an intermission of two or three days; then scattered rains fell to the close of the month. This abnormal amount of rainfall, while reviving crops and vegetation generally, was injurious in many sections, flooding districts contiguous to the main water courses, where were some of the most promising crops. The rains came too late to materially benefit the early portion of the corn crop, except in a few favored localities, and much of it has been cut and stacked for winter forage. The late corn was wonderfully improved and gives promise of fair yields. Cotton was benefited by the rains, which caused renewed growth and fruitage; picking was becoming general at the end of the month. Tobacco continued in excellent condition.—*H. C. Bate.*

Texas.—The mean temperature was 85.2°, or 2.4° above normal; the highest was 115°, at Haskell on the 28th, and the lowest, 60°, at Amarillo on the 4th, Texarkana on the 12th, and Anna on the 19th. The average precipitation was 0.55, or 1.04 below normal; the greatest monthly amount, 8.08, occurred at Sulphur Springs, while none fell at Fort McIntosh.

The weather during the month was eminently unfavorable to farming interests, and, except in a few favored localities, crops of all kinds were backward. From the Trinity River eastward to the border, in the valleys of the lower Brazos and Colorado rivers, and in southern sections of the Panhandle rain fell in sufficient amounts; elsewhere throughout the State it was very dry, and a drought of almost unprecedented severity prevailed over the central, southern, and southwestern sections. Cotton matured rapidly, and, in many cases, prematurely, and picking became general by the middle of the month. Late cotton showed some improvement where rain fell, but considerable shedding was reported, and much damage was done by rust and boll weevil; in the dry districts this crop was very backward, and by the close of the month was in a critical condition. Corn matured much earlier than usual, and by the end of the month the early planted was being gathered. Rice and sugar cane did fairly well; hay and other forage crops were secured in reasonably good condition; vegetables were scarce.—*N. R. Taylor.*

Utah.—The mean temperature was 72.3°, or 2.4° above normal; the highest was 111°, at Fish Springs on the 13th, and the lowest, 31°, at Loa on the 31st. The average precipitation was 1.63, or 1.08 above normal; the greatest monthly amount, 5.07, occurred at Pinto, and the least, trace, at Fish Springs and Kelton.

The rainfall was the heaviest that has occurred during the month of August for many years.—*L. H. Murdoch.*

Virginia.—The mean temperature was 74.7°, or 0.5° above normal; the highest was 98°, at Manassas on the 5th and at Stephens City on the 9th and 11th, and the lowest, 43°, at Burkes Garden on the 8th. The average precipitation was 8.86, or 4.79 above normal; the greatest monthly amount, 17.58, occurred at Grahams Forge, and the least, 3.45, at Birdsnest.

There was too much cloudiness and moisture during the month for best results either in crop growth and maturity or in farm work. Plowing and other preparation for fall seeding was also much retarded. Considerable corn was cut, however, fodder saved, and tobacco cut and cured.—*Edward A. Evans.*

Washington.—The mean temperature was 67.5°, or 2.0° above normal; the highest was 111°, at Pasco and Hooper on the 15th, and the lowest, 37°, at Wilbur on the 27th and Usk on the 30th. The average precipitation was 0.12, or 0.70 below normal; the greatest monthly amount, 0.67, occurred at Ashford, while none fell at Cheney, Ilwaco, Silvana, Ritzville, Sprague, and Waterville.

The entire month was warm and very dry, with not sufficient precipitation to lay the dust or to materially help gardens, potatoes, pastures, and orchards, which have been suffering very much. Still it was ideal harvest weather, all the crops being secured in prime condition.—*William Bell.*

West Virginia.—The mean temperature was 73.6°, or about normal; the highest was 98°, at Wheeling on the 10th, and the lowest, 43°, at Philippi on the 8th. The average precipitation was 5.14, or 1.58 above normal; the greatest monthly amount, 9.92, occurred at Bluefield, and the least, 1.64, at Point Pleasant.

Droughty conditions were quite generally broken during the forepart of August, and crops were greatly revived, but early corn and potatoes had been considerably damaged. Farm work was somewhat delayed by the showery weather, but the rain put the ground in fair condition for fall plowing, and considerable progress was made. Thrashing was generally well along, but the yield was not meeting expectations. Apples were wormy and still falling badly, and the yield will be a light one, except in the Panhandle section; peaches were plentiful, but small and of inferior quality; grapes were rotting and mildewing to some extent, and only a fair crop was anticipated.—*E. C. Vose.*

Wisconsin.—The mean temperature was 69.4°, or 1.5° above normal; the highest was 100°, at Medford on the 21st, and the lowest, 34°, at Barron on the 31st. The average precipitation was 1.73, or 1.27 below normal; the greatest monthly amount, 5.29, occurred at Butternut, and the least, 0.25, at Darlington.

There was a general improvement during the month in the crop conditions especially in the southern counties where the drought of July was most severe. Corn that was considered dead recuperated to a considerable extent, and in many localities will make a fair crop. Tobacco is very uneven, good in some localities, in others poor. In the central and northern sections corn and grain crops are good and the hay crop exceptionally heavy.—*W. M. Wilson.*

Wyoming.—The mean temperature was 66.6°, or 0.9° above normal; the highest was 102°, at Embar on the 1st and at Bitter Creek on the 2d and 7th, and the lowest, 21°, at Daniel on the 10th and 11th. The average precipitation was 0.95, or 0.11 above normal; the greatest monthly amount, 3.06, occurred at Centennial, and the least, trace, at Leo and Myersville.

The month has been very satisfactory to the farming and grazing interests of the State. The continued warm weather has prevented much damage to gardens by frosts, and at the same time matured the third crop of alfalfa in the southeastern and the second crop in the southwestern portion of the State. Frequent showers have assured abundant stock water in most sections, and have been of great benefit to late gardens.—*L. H. Dangerfield.*

SPECIAL CONTRIBUTIONS.

HAWAIIAN CLIMATOLOGICAL DATA FOR AUGUST.

By CURTIS J. LYONS, Territorial Meteorologist.

Meteorological observations at Honolulu, August, 1901.

The station is at 21° 18′ N., 157° 50′ W.

Hawaiian standard time is 10h 30m slow of Greenwich time. Honolulu local mean time is 10h 31m slow of Greenwich.

Pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

The rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time, on the respective dates.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet, and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m., Greenwich time, or 2.29 a. m., Honolulu time.									Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.			Sea-level pressures.		
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.	Average cloudiness.	Maximum.	Minimum.	
	*	†	†			‡	‡		§				
1	30.00	76	69.5	83	71	64.5	63	ne.	3	5	30.03	29.93	0.01
2	29.98	74	69	85	73	65.5	64	ne.	3	3	30.03	29.97	0.07
3	29.94	75	68.5	84	74	66.5	67	ne.	4	3	30.03	29.96	0.11
4	29.93	74	69	84	72	65.5	67	ne.	4-3	4	29.97	29.90	0.07
5	29.93	76	68.5	85	72	65.0	64	ne.	3-2	3	29.97	29.89	0.00
6	29.94	76	69	84	74	65.7	63	ne.	3-4	3	29.96	29.88	0.00
7	29.94	75	68.5	85	75	66.0	63	ne.	3-4	1-4	29.96	29.89	0.01
8	29.92	70	68	85	73	65.3	64	ne	3-1	6	29.97	29.90	0.03
9	29.92	70	67	82	70	67.7	76	ne se.	2-0	7	29.95	29.88	0.00
10	29.96	77	71	87.5	67	67.7	71	sw-ne.	0-3	7-3	29.98	29.90	0.00
11	29.94	78.5	72.5	86	76	69.7	71	ne.	3	6-3	29.99	29.91	0.04
12	29.96	77	70.5	85	76	69.5	69	ene.	4	4-10	30.00	29.92	0.00
13	29.95	76	70.3	86	77	66.7	65	ne.	3	4-1	29.99	29.91	0.00
14	29.94	76	70.5	86	75	69.0	71	ne.	3	4-1	29.99	29.89	0.00
15	29.94	70	68	86	75	66.7	65	ne.	3	3-0	29.97	29.89	0.00
16	29.94	76	69	86	69	67.7	71	ne.	3	4	29.98	29.91	0.00
17	29.94	72	70	86	74	66.5	66	ne.	3	3-6	29.98	29.91	0.16
18	29.93	70	67	86	71	68.3	74	ne.	3-0	4	29.96	29.89	0.00
19	29.96	71	69.7	87	69	69.3	76	ne.	3-0	2-7	29.98	29.89	0.01
20	30.00	76	70	85	70	69.5	75	s-ne.	0-3	7-2	30.01	29.96	0.01
21	29.96	76	70	85	76	67.7	67	ne.	2-4	5	30.03	29.95	0.02
22	29.94	77	69	85	74	67.0	66	ne.	3-4	5-2	30.02	29.91	0.01
23	29.95	77	70	85	76	66.0	64	ne.	4	5	29.97	29.90	0.10
24	29.99	78	71	84	70	67.0	66	ne.	4	5	30.03	29.94	0.01
25	30.01	76	70.5	85	76	67.5	65	ne.	4-5	4	30.05	29.96	0.00
26	30.00	76	68	83	75	66.5	68	ne.	3-5	6	30.07	29.98	0.05
27	29.98	76	69	85	73	63.7	60	ne	4-3	3	30.05	29.95	0.01
28	29.99	77	71.7	85	74	68.3	71	ne	4-2	3	30.03	29.96	0.25
29	30.02	76	70	85	72	70.0	72	ne.	3	5-3	30.05	29.96	0.05
30	30.00	78	71.5	85	74	68.5	69	ne.	3-2	3	30.04	30.00	0.01
31	30.01	78	69.5	85.5	77	68.5	68	ne.	3-4	5-3	30.05	29.99	0.00
Sums	......	......	......	......	......	......	......	....	.....	.....	......	......	1.03
Means	29.972	75.1	69.5	85.1	73.4	67.3	67.8	....	3.2	4.0	30.000	29.925	......
Departure	−0.012	......	......	......	......	+1.3	−0.2	....	.....	0.0	......	......	−1.09

*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:31 p. m., Greenwich time. ‡These values are the means of (6+9+2+9) ÷ 4. §Beaufort scale.

Mean temperature for August, 1901 (6+2+9) ÷ 3=78.7°; normal is 77.6°. Mean pressure for August (9+3) ÷ 2=29.964; normal is 29.976.

GENERAL SUMMARY FOR AUGUST, 1901.

Temperature mean for the month, 78.7; normal, 77.6; average daily maximum, 85.1; average daily minimum, 73.4; average daily range, 11.7; greatest daily range, 20.5; least daily range, 8.0; highest temperature, 87.5; lowest, 67.

Barometer average, 29.964; normal, 29.976 (correcting for gravity by —.06); highest, 30.07, on the 31st; lowest, 29.88, on the 17th; greatest 24-hour change, .06. Pressure was low during the first half of the month, and high during the last half. This is the fifth successive month of barometer lower than normal.

Relative humidity, 67.8 per cent; normal, 68; mean dew point, 67.3; normal, 66.0; mean absolute moisture, 7.31 grains to the cubic foot; normal, 7.01.

Rainfall, 1.03 inches; normal, 2.12; rain record days, 19; normal, 18; greatest rainfall in one day, 0.25; total at Luakaha, 4.61; at Kapiolani Park, 0.15. Total rainfall since January 1, 23.97; normal, 22.74.

The artesian well at Punahou is not in order for record; from other wells no record. The average daily mean sea level was 10.38 feet on the scale, 10.00 representing the assumed annual mean.

For the latter half of the month there were almost no upper current clouds.

Trade wind days 30 (0 of north-northeast); normal for August, 29. Average force of wind (during daylight), Beaufort scale, 3.2. Cloudiness, tenths of sky, 4.0; normal, 4.0.

Rainfall data for the Hawaiian Service.

Stations.	Elevation.	August, 1901.	Stations.	Elevation.	August, 1901.
HAWAII.			MAUI—*Continued.*	*Feet.*	*Inches.*
HILO, e. and ne.	*Feet.*	*Inches.*	Hamoa Plantation, se	60	3.43
Waiakea	50	6.86	Nahiku, ne	60	4.28
Hilo (town)	100	5.89	Nahiku (Lemaon), ne	850	9.28
Kaumana	1,250	10.09	Haiku, n	700	1.87
Pepeekeo	100	5.92	Kula (Erehwon), n	4,500	....
Hakalau	200	....	Puuomalei, n	1,400	....
Honohina	300	....	Paia, n	180	0.38
Laupahoehoe	500	....	Haleakala Ranch, n	2,000	0.53
Ookala	400	1.34	Wailuku	200	....
HAMAKUA, ne			LANAI.		
Kukaiau	250	0.27	Keomuku, e	6	....
Paauilo	750	0.38	OAHU.		
Paauhau Mill (Gibb)	300	0.08	Punahou (W. B.), sw	47	1.03
Paauhau (Greig)	1,150	0.24	Kulaokahua, sw	50	0.54
Honokaa (Muir)	425	0.39	Kewalo (King street), sw	15	0.50
Honokaa (Rickard)	1,900	0.61	United States N. S., sw	6	0.33
Kukuihaele	700	1.52	Kapiolani Park, sw	10	0.15
KOHALA, n.			Manoa (Woodlawn Dairy), c.	285	3.58
Awini Ranch	1,100	....	Makiki Reservoir	150	1.04
Niulii	200	1.21	School street (B shop), sw.	50	1.41
Kohala (Mission)	521	0.69	Pacific Heights, sw	700	2.98
Kohala (Sugar Co.)	235	0.58	Insane Asylum, sw	30	1.21
Hawi	300	....	Kalihi-uka	260	3.29
Hawi Mill	600	....	Nuuanu (W. W. Hall), sw	50	1.06
Waimea	2,720	1.82	Nuuanu (Wyllie street), sw.	250	2.95
KONA, w.			Nuuanu (Elec. Station), sw.	405	3.01
Kailua	930	5.20	Nuuanu (Luakaha) c	850	4.61
Kealakekua	1,580	5.31	Waimanalo, ne	25	0.57
Napoopoo	25	....	Maunawili, ne	300	2.32
KAU, se.			Kaneohe, ne	100	....
Kakuku	1,680	3.34	Ahuimanu, ne.	350	3.82
Honuapo	15	1.97	Kahuku, n	25	1.76
Naalehu	650	3.49	Waialua, n	20	....
Hilea	310	1.30	Wahiawa, c.	900	....
Pahala	850	0.95	Ewa Plantation, s	60	....
Moaula	1,700	1.54	Waipahu, s.	200	0.00
PUNA, e.			Moanalua, sw.	15	0.69
Volcano House	4,000	2.13	KAUAI.		
Olaa	......	....	Lihue (Grove Farm), e	200	3.79
Olaa	......	....	Lihue (Molokoa), e	300	2.90
Kapoho	110	4.80	Lihue (Kukaua), e	1,000	5.27
Kalapana, se	8	....	Kealia, e	15	....
MAUI.			Kilauea, ne	325	4.83
Olowalu	......	....	Hanalei, n	10	5.32
Lahaina	......	....	Waiawa, sw	32	0.24
Waiopae Ranch, s	700	0.36	Eleele, s.	200	2.42
Kaupo (Mokulau), s	285	4.44	Waiawa, Mountain, s	2,100	12.19
Kipahulu, s.	300	5.57	McBrides (Res.)	850	5.30

Records not hitherto published, July, 1901.

Kohala Sugar Company	......	1.27	Kahikinui (Maui)	......	0.34
Kapoho	......	4.89	Kealia Kauai	......	4.27
Laupahoehoe	......	2.74	Hilo	......	7.24

NOTE.—The letters n. nw. e. sw. se ne. and s. attached to each name indicate the exposure or direction toward which localities face; "c," central locality.

Percentages of district rainfall as compared with normal: Hilo, 50 per cent; Hamakua, 8; Kohala, 20; Waimea, 52; Kona, 80; Kau, 45; Puna, 100; Maui, variable, 25 to 100; Oahu, 50, except north point, 100; Kauai, 100. The drought in north Hawaii is very serious, and is accompanied by destructive forest fires. The entire absence of any shifts in the trade wind either toward north or east may be an immediate cause of the lack of rain.

Mean temperatures: Pepeekeo, Hilo district, 100 feet elevation, average maximum, 79.9; average minimum, 71.0;

Waimea, Hawaii, 2,730 elevation, 76.5 and 66.8; Kohala, 521 elevation, 82.3 and 72.4; Kulaokahua, W. R. Castle's, 60 feet elevation, highest, 89; lowest, 69; mean, 78.6.

Sea was smooth first half of month; heavy swell noted toward the end of month.

Snow still visible on Mauna Kea. No earthquakes reported.

A sudden rise of the sea, or "tidal wave" of about four feet occurred at Kailua, west coast of Hawaii, on the 8th about 11 a. m. It was noticed down that coast to the southward, but not elsewhere, and barely appeared as a disturbance of about two inches on the Honolulu tide gage. According to the papers seismic disturbances took place in Japan about that time, but not early enough for the passage of a wave to this port. The limited range of this wave would seem to indicate a near source for the disturbance.

CLIMATOLOGICAL DATA FOR JAMAICA.

Through the kindness of Mr. Maxwell Hall, the following data are offered to the MONTHLY WEATHER REVIEW in advance of the publication of the regular monthly weather report for Jamaica:

Jamaica, W. I., climatological data, August, 1901.

	Negril Point Lighthouse.	Morant Point Lighthouse.
Latitude (north)	18° 15′	17° 55′
Longitude (west)	78° 23′	76° 10′
Elevation (feet)	33	8
Mean barometer, 7 a. m.	29.914	29.924
Mean barometer, 3 p. m.	29.885	29.888
Mean temperature, 7 a. m.	78.6	....
Mean temperature, 3 p. m.	83.5	....
Mean of maxima	87.9	....
Mean of minima	73.6	....
Highest maximum	90.0	....
Lowest minimum	69.0	....
Mean dew-point, 7 a. m.	74.2	....
Mean dew-point, 3 p. m.	77.4	....
Mean relative humidity, 7 a. m.	86.0	....
Mean relative humidity, 3 p. m.	82.0	....
Total rainfall (inches)	7.54	8.23
Average wind direction, 7 a. m.	var.	ene.
Average wind direction, 3 p. m.	var.	ne.
Average hourly velocity, miles, 7 a. m.	6.9	8.2
Average hourly velocity, miles, 3 p. m.	10.0	10.6
Average cloudiness (tenths):		
7 a. m. Lower clouds	0.3	1.4
7 a. m. Middle clouds	1.2	2.0
7 a. m. Upper clouds	3.6	1.2
3 p. m. Lower clouds	1.4	1.4
3 p. m. Middle clouds	6.4	2.0
3 p. m. Upper clouds	0.5	1.1

NOTE.—The pressures are reduced to standard temperature and gravity. to the Kew standard, and to mean sea level. The thermometers are exposed in Stevenson screens.

Comparative table of rainfall for August.

(Based upon the average stations only.)

Divisions.	Relative area.	Number of stations.	Rainfall.	
			Average.	1901.
Northeastern division	25	22	7.27	5.73
Northern and subcentral division	22	50	4.47	5.10
Western-central division	26	22	9.86	9.47
Southern division	27	31	5.18	5.67
General means	100	125	6.69	6.49

In taking the average rainfall Mr. Hall uses only those stations for which he has several years of observation, so that the column of averages represents fairly well the normal rainfall for each division, while the column for the current month represents the average rainfall at those same stations. The relative areas of the divisions are very nearly the same and are given in the preceding table as expressed in percentages of the total area of Jamaica. The number of rainfall stations utilized in each area varies slightly from month to month, according as returns have come in promptly or not, but will not differ greatly from the numbers in the second column of the table.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

TABLE 1.—*Hourly observations at the Observatory, San Jose de Costa Rica, during August, 1901.*

Hours.	Pressure.		Temperature.		Relative humidity.		Rainfall.		
	Observed, 1901.	Normal, 1889-1900.	Observed, 1901.	Normal, 1889-1900.	Observed, 1901.	Normal, 1889-1900.	Observed, 1901.	Normal, 1889-1900.	Duration, 1901.
	660+ Mm.	660+ Mm.	° C.	° C.	%	%	Mm.	Mm.	Hrs.
1 a. m.	3.80	3.76	17.42	17.40	90	91	0.0	0.7	0.00
2 a. m.	3.43	3.36	17.22	17.49	89	91	0.0	0.5	0.00
3 a. m.	3.17	3.11	16.84	17.07	91	92	0.0	0.4	0.00
4 a. m.	3.17	3.07	16.52	16.92	91	91	0.0	0.3	0.00
5 a. m.	3.27	3.19	16.41	16.78	90	91	0.0	0.5	0.00
6 a. m.	3.50	3.44	16.47	16.72	89	91	0.0	0.7	0.00
7 a. m.	3.78	3.74	18.13	18.08	85	88	0.1	1.1	0.17
8 a. m.	4.08	4.03	20.15	20.01	76	81	0.2	2.0	0.25
9 a. m.	4.27	4.23	22.37	21.83	69	75	0.0	1.3	0.00
10 a. m.	4.38	4.28	23.97	23.33	66	70	0.0	2.2	0.00
11 a. m.	4.28	4.12	24.67	24.17	65	70	0.0	3.1	0.00
12 m.	3.91	3.75	25.62	24.49	64	69	8.0	6.1	1.58
1 p. m.	3.37	3.36	25.18	24.21	66	70	4.1	9.4	2.67
2 p. m.	2.94	2.92	24.24	23.46	72	72	10.7	23.2	2.50
3 p. m.	2.67	2.64	22.99	22.82	77	76	31.3	30.5	4.82
4 p. m.	2.67	2.59	21.38	21.14	83	82	52.8	33.2	5.37
5 p. m.	2.95	2.91	20.21	20.26	86	84	63.7	43.3	9.26
6 p. m.	3.42	3.25	19.52	19.55	90	87	78.9	30.6	10.74
7 p. m.	3.84	3.65	19.07	18.90	92	90	34.4	26.1	9.00
8 p. m.	4.07	4.00	18.70	18.59	92	89	31.1	18.8	8.26
9 p. m.	4.28	4.27	18.47	18.28	92	90	22.2	7.8	6.67
10 p. m.	4.43	4.44	18.17	18.02	93	92	4.0	3.7	3.89
11 p. m.	4.38	4.39	17.99	17.80	90	90	0.1	2.1	0.66
Midnight	4.18	4.14	16.72	17.65	91	91	0.0	1.2	0.00
Mean	663.68	663.61	19.98	19.75	83	84	......	......	......
Minimum	661.5	660.63	14.4	13.2	......	......	......	......	......
Maximum	665.8	666.72	29.1	29.3	......	......	18.4	......	......
Total	......	......	......	......	......	......	341.6	248.8	65.84

REMARKS.—The barometer is 1,169 meters above sea level. Readings are corrected for gravity, temperature, and instrumental error. The dry and wet bulb thermometers are 1.5 meters above ground and corrected for instrumental errors. The hourly readings for pressure, wet and dry bulb thermometers, are obtained by means of Richard registering instruments, checked by direct observations every three hours from 7 a. m. to 10 p. m. The hourly rainfall is as given by Hottinger's self-register, checked once a day. Under maximum, the greatest hourly rainfall for the month is given. The standard rain gage is 1.5 meters above ground. In the Costa Rican system the San Jose local time is used, which is 0^h 36^m 13.3^s slower than seventy-fifth meridian time.

TABLE 2.

Time.	Sunshine.		Cloudiness observed, 1901.	Temperature of the soil at depth of—				
	Observed 1901.	Normal, 1889-1900.		0.15 m.	0.30 m.	0.60 m.	1.20 m.	3.00 m.
	Hours.	Hours.	%	° C.	° C.	° C.	° C.	° C.
7 a. m.	15.85	7.32	......	21.17	21.48	22.03	21.86	21.56
8 a. m.	25.13	18.22	......	......	......	......	......	......
9 a. m.	25.25	19.95	......	......	......	......	......	......
10 a. m.	21.19	17.86	......	21.50	21.53	22.08	21.88	......
11 a. m.	19.00	15.63	......	......	......	......	......	......
12 m.	13.21	12.96	......	......	......	......	......	......
1 p. m.	13.21	12.37	......	21.97	21.68	22.07	21.79	......
2 p. m.	11.71	11.22	......	......	......	......	......	......
3 p. m.	8.59	9.03	......	......	......	......	......	......
4 p. m.	4.16	5.87	......	22.04	21.72	22.04	21.83	......
5 p. m.	1.84	2.72	......	......	......	......	......	......
6 p. m.	0.75	0.83	......	......	......	......	......	......
7 p. m.	......	......	......	21.91	21.73	22.00	21.82	......
8 p. m.	......	......	......	......	......	......	......	......
9 p. m.	......	......	......	......	......	......	......	......
10 p. m.	......	......	......	21.74	21.69	22.03	21.82	......
11 p. m.	......	......	......	......	......	......	......	......
Midnight	......	......	......	......	......	......	......	......
Mean	......	......	......	21.72	21.67	22.03	21.84	21.56
Total	159.80	134.09	......	......	......	......	......	......

Notes on the Weather.—In San Jose, air pressure, temperature, and relative humidity have been quite close to the normal of the month; rainfall was rather in excess, and the same is also true of sunshine, on account of the predominance of clear skies during the morning hours; four days only were rainless, and a specially heavy shower fell on the 16th; total amount, 56 millimeters, of which 32 millimeters fell in two hours. On the Atlantic slope, rains were less abundant than during the preceding months on the coast belt, rather scarce along the foothills and in the Reventazon Valley, and excessive in the mountains of Sarapiqui and San Carlos.

Notes on earthquakes.—August 13, 1:48 p. m., slight tremor, NE–SW; intensity 1; duration, (?)

TABLE 3.—*Rainfall at stations in Costa Rica, August*, 1901.

Stations.	Amount.	No. rainy days.	Stations.	Amount.	No. rainy days.
	Mm			*Mm.*	
1. Sipurio (Talamanca)	155	18	14. Juan Vinas	118	16
2. Boca Banano	258	14	15 Santiago	111	17
3. Limon*	......	......	16 Paraiso	218	20
4. Swamp Mouth*	......	......	17. Las Concavas	176	19
5. Zent*	......	......	18. Cartago	163	19
6. Gute Hoffnung	133	10	19. Tres Rios	290	22
7. Siquirres*	......	......	20. S. Francisco G	367	24
8. Guapiles	168	15	21. San Jose	342	27
9. Sarapiqui	450	26	22. La Verbena	313	27
10. San Carlos	440	20	23. Nuestro Amo	317	22
11. Las Lomas	141	7	24. Alajuela	318	16
12. Peralta	168	15	25. San Isidro Alajuela	553	22
13. Turrialba†	......	......			

*Observations not received. †July, 401 mm.;—30 days.

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of Señor Manuel E. Pastrana, Director of the Central Meteorologic-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the Boletin Mensual. An abstract, translated into English measures, is here given, in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means are now reduced to standard gravity.

Mexican data for August, 1901.

Stations.	Altitude.	Mean barometer.*	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
	Feet.	*Inch.*	*°F.*	*°F.*	*°F.*	%	*Inch.*		
Chihuahua	4,669	25.28	86.0	68.0	74 5	66	......	......	......
Colina	1,600	28.23	91.0	67.5	77.5	86	8.43	sw.	......
Guanajuato	6,640	23.71	88.0	51.8	69.4	58	5.58	ene.	......
Leon (Guanajuato)	5,906	24.26	84.9	52.9	69.4	61	3.25	se.	......
Linares (Nuevo Leon)	1,188	28.61	97.7	68.0	81.9	73	1.97	s.	......
Mazatlan	25	29.82	91.9	74.1	83.5	79	11.86	nw.	e.
Mexico (Obs. Cent.)	7,472	23.02	77.0	50.9	62.2	69	2.91	nw.	sw.
Monterrey (Sem)	1,626	28.12	102.9	69.4	85.1	63	0.75	e.	......
Morelia (Seminario)	6,401	23.93	75.2	48.2	63.1	77	6.24	s.	e.
Pachuca	795	22.46	73.4	50.0	62.1	72	9.49	ne.	......
Puebla (Col. Cat.)	7,125	23.36	75.9	53.6	64.4	73	8.85	ese.	ssw.
Saltillo (Col. S. Juan)	5,399	24 77	89.6	59.0	72.5	66	11.81	ne.	......
S Isidro (Hac. de Gto)	......	......	77.4	67.1	......	......	6.72	ne.	......
Toluca	8,812	21.94	73.8	33.8	57.9	77	5.54	se.	......

*Reduced to standard temperature and gravity.

THE ISLAND OF PORTO RICO.

By JOSEPH L. CLINE, Observer, U. S. Weather Bureau.

Porto Rico is within the Tropical West Indies, between latitudes 17° 50′ and 18° 30′ north, and longitudes 65° 30′ and 67° 15′ west from Greenwich. It lies east of Haiti, being separated from it by Mona Passage, and it is the smallest and easternmost island of the Greater Antilles. It was discovered by Columbus, November 16, 1493, during his second voyage to the Western Hemisphere. He first sighted Cape Mala Pascua, and then sailed along the south and east coast to Aguada, where he landed November 19, and took possession of the island in the name of the reigning sovereigns of Spain and christened it San Juan Bautista, in honor of Saint John the Baptist, while its Indian name was Borinquen. For fourteen years after its discovery the island remained unexplored. Trading vessels stopped there occasionally, usually for water, but it was not until 1508 that Ponce de Leon made his landing from Santo Domingo and established a form of government other than that of the Indians; he founded the town of Caparra, about three miles inland from the bay of San Juan, in 1509, which was afterward named Puerto Rico, or Rich Gate, and transferred to the present site of San Juan. Subsequently the island and the city exchanged names, and the place where the first town was founded is now known as Pueblo Viejo, or old town. Porto Rico, owing to its location, practically controls the Virgin and Mona passages from the Atlantic Ocean into the Caribbean Sea, thus occupying a strategic position of much importance. Subsequent events show that this fact was recognized at an early date. Thus, in 1597, San Juan was blockaded and captured by Admiral George Clifford, Earl of Cumberland, but an epidemic of yellow fever forced him to give up the island. Two years previous San Juan fell before the assaulting forces of the great English sea rover Sir Francis Drake. These defeats led to the completion of Moro Castle at the entrance of the harbor of San Juan. A Dutch fleet of 17 vessels attacked San Juan in September, 1625; they landed and besieged the city for twenty-eight days, but were finally forced to withdraw with considerable loss. The French attempted a landing in 1625 but were repulsed. Several minor and unsuccessful attempts to capture the island from Spain occurred between 1625 and 1797. From this latter date to the time of the American occupation of the island in 1898, Porto Rico was exempt from outside attack.

The island is roughly rectangular in shape; it is a little over 100 miles in length, with a breadth of about 36 miles, thus containing about 3,600 square miles. Its greatest length is from east to west. The topography is broken by an irregular range of low mountains and hills which traverse the island from east to west, a little to the south of its center, trending northeastward over the eastern portion, and culminating with the peak of El Yunque (The Anvil) near the northeast corner, which overlooks the island with an altitude of 3,609 feet. Elsewhere these mountains are from 2,000 to 3,000 feet high. This range forms the water divide of Porto Rico, and is known in different parts of the island by various names—Cordillera Central, Sierra de Cayey, and in the northeast Sierra de Luquilla. The contour slopes northward and southward from this range of mountains in broad undulations, and is broken with deep ravines and creeks, some of which become unfordable rivers for a few hours after the heavy tropical rains. The largest streams are the Rios Loiza, Bayamon, Morovis, Arecibo, and Blanco, all on the north side of the divide, and some of which are navigable with small boats for a short distance inland. Most of the interior has a steep hilly surface, gradually becoming more level as the coast is approached. The coast land is low and with few good harbors, that of San Juan being the best. The small islands of Vieques and Culebra lay to the eastward of Porto Rico; the Isla Mona is to the west in the Mona Passage, with a few other islets in its neighborhood, and these are all controlled by the same government.

The climate is not so oppressive as one might expect in the Tropics. A cool, very pleasant, and most welcome breeze generally blows across the island, particularly in the afternoon and at night, which adds much to the comfort of the inhabitants. Much cloudy weather prevails, with an occasional fog

in the mountains. San Juan has an annual mean temperature of 78.5°. The warmest weather prevails from June to October, during which period the normal temperature ranges from 80.4° to 81.4°, with the highest in August, but slightly cooler weather prevails in the mountains. The coolest weather occurs in December, January, and February; during these months the normal temperature ranges from 75.2° to 76.5°, with the lowest in February. It is considered cold when the daily temperature ranges from 55° to 65°, and such temperatures are very uncomfortable to the natives. Temperatures of 50° or slightly below have been recorded in the mountainous portions, and it is reported that light frost has been noted on some of the highest points, but no meteorlogical records report frost. The highest temperature recorded at San Juan during the past two years, or since American occupation, was 93.2° on May 2, 1901, and 93° was recorded April 25, 1900; the lowest was 65°, December 26, 1899. The temperatures at San Juan, the only station mentioning continuous self-registers, range generally from 65° to 89° during January, February, March, November, and December, and from 66° to 93° during the other months of the year.

January, February, and March are the driest months, and during this period the rainfall is less than 3 inches per month. The greatest monthly rainfall occurs in October and November, but the so-called wet season generally commences in April and continues into December. Droughts, very destructive to vegetation, are noted in some years. The average annual rainfall at San Juan is 54.50 inches, while at Hacienda Perla, a station in the northeast part of the island, on El Yunque, it is 133.93 inches. The greatest annual rainfall at San Juan, from a record of twenty-five years, was 82.66 inches in 1878, and the least was 36.64 inches in 1893. The greatest monthly rainfall was 17.66 inches in December 1893, and the least was 0.24 inch in February, 1896.

The forest areas are small and almost entirely confined to the highest mountains, with few scattering remains of the primeval forests. Timber is very scarce, and most of that used in buildings is imported.

More than one-fifth of the island is under cultivation, and crops yield well considering the manner of tillage; the mountains are cultivated, even to the summit. Hoeing for the purpose of freeing the ground of pernicious vegetation is usually performed by cutting away the growth with blows of the machette, a large knife. Improved methods of farming are greatly needed. Much coffee is grown, and growers modify the climate by employing shade for coffee trees. The select and celebrated coffee is produced in regions lying between 200 and 800 meters above sea level. The cultivation of coffee occupies about 41 per cent of the total land under cultivation, sugar cane 15, bananas 14, and the balance is divided among small crops, such as sweet potatoes, indian corn, malangas, rice, tobacco, cocoanuts, okra, lerenes, cassava or yuca, tania, yams, plantains, squashes, watermelons, cantaloupes, cabbage, lettuce, turnips, celery, radishes, beets, caimito, ausuba, May apples, mangos, zapote, nispero, cocoa plum, multa, pajuil, calambrenas, West Indian grapes, breadfruit, indian chestnuts, figs, West Indian nuts, currants, cherries, peanuts, beans, custard apples, heart fruit, guanabana, guava, cucumbers, Mexican fruit, eggplants, tomatoes, pepper, carrots, pineapples, water cresses, gundas, cactus pyaya, papaws, oranges, lemons, limes, cayure, bixa, jagua, barley, strawberries, tamarindos, and cotton. The cotton plant is said to live nine years and grows to be a tree of considerable size, but very little use is made of the fiber. The island abounds in cocoa, indigo, and many medicinal plants, but they are not used to a very great extent.

Transportation is very difficult. The French railway now extends part of the way around the western end of the island, but there are no other railroads except a trolley line connecting the beautiful suburbs at San Turce with San Juan, the capital. Aside from the military wagon road, constructed by the Spanish Government from San Juan to Ponce, there are no roads worthy of name, except those now under construction by the United States Government. Transportation over other routes is by means of pack trains, and the writer spent a few miserable days trying to travel along the mountain range by pack saddle.

The population is mixed blood, white, negro, and Indian, with the whites predominating. The island has 264 inhabitants to the square mile, and the density of population is seven times that of Cuba and twice that of New York State. Spanish is now the acknowledged language, but many speak English; English is being taught in the public schools and in a few more years will be the dominating language. The better classes are well educated, highly civilized, and congenial, but very few of the peons, or laboring class, can read or write. The peons, or at least many of them, live from hand to mouth; some never sat down at a table to eat; sometimes a great many sleep in one room like cattle in a pen, yet they always seem to be happy and contented.

Witchcraft is generally an accepted fact among the lower classes; as much so as was the case among the New England pioneers of the United States two hundred years ago. It does not, however, reach the extremity of superstition that is said to reign in Jamaica, Haiti, and Santo Domingo, nor does it have its professional ministers, save that some persons are believed to possess the evil eye, which is undoubtedly a recognition of hypnotic power. Many charms and amulets are used for warding off sickness and trouble.

San Juan, the capital of Porto Rico, is a quaint, old-fashioned town, presenting the odd architectural type which originated with the conquistadors, and still survives throughout the wide possessions that fell under their conquering standards during the fifteenth and sixteenth centuries. It is a composite of what might be termed the "Medievo-Mayan" style, in which the prevailing modes of the middle ages of the Spanish Peninsula were blended with the massive and severe lines of the ancient Peruvians and Mexicans, with whose pueblos, or villages, the conquerors had become so familiar. It is a method of structure that can not be improved upon where earthquakes and hurricanes may be expected, though Porto Rico has never suffered from either to any great extent, except from a hurricane in 1899. All buildings, except those of the peasant poor, which are made of palms and wild grass, are constructed of thick stones or brick walls, surmounted by huge beams supporting flat roofs of brick or tiling. Until recently the buildings were only one story high, but within the past few years the South American and West Indian cities have become slowly modernized, and three-storied structures may be seen in many of them. All other towns in Porto Rico are constructed after the pattern of San Juan, and the largest building in each is a church centrally located. The streets of San Juan are all paved, mostly with brick, and well lighted with both gas and electricity. The city also has a well-managed clubhouse, public library, water system, gas and electric light plants, ice factory, telephone system, and an electric railway. It has a history—a tragic chapter, lurid with fire, red with blood, pulsating with every form of human misery; a history not surpassed in horror by that of any other place. The sea walls surrounding the city, 50 to 60 feet high and 20 to 30 feet thick, are majestic to behold. These represent ages of work, done by the Indian slaves under lash, but the aborigines that once roamed at will over this picturesque island no longer live to tell the tale. Yet their musical instruments, such as drums of various sizes, made out of the hollow trunks of trees, or the macara and the guicharo, made of the dried fruit of the calabash tree, survive them. These instruments may

yet be said to be the national musical instruments of the island, for they are still used in the dances of the Gibaros. The guicharo, a long calabash shell indented and played upon with a stick, was used at balls in society as an accompaniment to the piano and other modern instruments, and was even adopted by the Spanish military bands when they played the country dances. The writer was once welcomed to the island by a serenade from a party of natives with their crude musical instruments.

THE METEOROLOGICAL OBSERVATORY OF SAINT IGNATIUS COLLEGE, CLEVELAND, OHIO.

By James Kenealy, Local Forecast Official, dated Sept. 27, 1901.

In furtherance of the expressed wish of the Chief of the Weather Bureau that due credit be given, as far as practicable, to the various cooperating observers scattered throughout the country, who, in their earnest desire for the advancement of science are unselfishly contributing much of their valuable time, day after day, in a labor of love that inures to the general welfare of the public, I take pleasure in submitting, for publication in The Review, some interesting facts in the history of an educational institution of this city which, for several years past, has furnished valuable reports to the Bureau.

Saint Ignatius College, Cleveland, Ohio, is an outgrowth of a school which was opened by the Society of Jesus for the reception of day pupils, in September, 1886. It was incorporated under the laws of Ohio on December 29, 1890, with power to confer the ordinary degrees. Five years later the establishment of an observatory was decided upon, as a means of encouraging pupils to pursue investigations in natural science. Between the two kinds of observatories, astronomical and meteorological, the fathers chose the latter, in deference to the wishes of the Reverend Father Odenbach, who felt a strong desire to extend the chain of meteorological observatories then under the direction of the order in the various countries of the globe, and which numbered about twenty, so as to include one in the United States. Thus was established, in 1895, the first meteorological observatory of the Jesuits in this country, and at the present time it is the only one. Among those in other countries, the ones which, perhaps, have attracted the most attention are the Rome Observatory, by reason of the work of the renowned astronomer, Secchi, its director for many years; the Havana Observatory, of which Father Viñes was in charge; and the Manila Observatory in the Phillipines. Father Frederick L. Odenbach was appointed director of the Cleveland Observatory, and still retains the position. In his appointment the college made no mistake, for the director, besides being an enthusiastic meteorologist and an accomplished physicist, has shown himself to be an indefatigable worker. From slender means he has succeeded in equipping the observatory with a very complete line of meteorological instruments, including not only those usually found at first-class stations of our Bureau, but also the spectroscope, thermopile, nephoscope, electroscope, a Secchi meteorograph, and a lightning recorder, with a Lodge coherer. "Home made" parts of self-registering attachments to several of the instruments bear evidence of natural ingenuity and mechanical skill on the part of the director or his assistants.

The Secchi meteorograph is an object of great interest to visitors. It stands 9 feet high on its base, and is itself 6 feet high and 3 deep, and weighs 600 pounds. The pendulum alone weighs 50 pounds, and 81 pounds of mercury are required to fill and float the barometer. It gives a continuous record of the pressure, the temperature, the velocity, and direction of the wind, and the beginning of rain. Father Secchi, who was one of the greatest among the pioneers in meteorology, began his work on this instrument in 1852, and completed it in 1867. The apparatus was then placed on exhibition in Paris, and won for its maker the decoration of the Legion of Honor.[1]

During the few years of its existence the observatory has done a great amount of work along special lines, such as cloud photography and cloud study, observations of the conditions of the air at higher altitudes by means of scientific kite flying, and observations of ground temperature at certain depths. Besides his lectures on the natural sciences as a part of the college course, the director found time last winter to give a series of six lectures of two hours each, on modern meteorology and the work of the United States Weather Bureau, to a large class of the teachers of our public schools, by whom they were appreciated as highly interesting and instructive. By such unselfish labors for the spread of education Father Odenbach is winning deserved popularity among all classes of our citizens.

Daily observations of the temperature of the ground since January, 1897, have been compiled, and the monthly means appear in the catalogue of the college for 1900–1901.

Father Odenbach was born at Rochester, N. Y., in 1857. He attended a parish school for five years, and received two years' instruction at the Rochester Collegiate Institute, preparatory to a course at the Rochester University. He left the University to enter Canisius College, Buffalo, N. Y., from which he was graduated in 1881. At this time he joined the Jesuits and went to Europe, where he continued his studies in mental philosophy, natural science, and mathematics. After his return he taught mathematics at Canisius College, Buffalo, N. Y., for three years. He then went to England for four years' further study, and on his return, in 1893, was appointed professor of physics and chemistry in Saint Ignatius College, Cleveland, Ohio, a position he still holds, together with subsequent assignments as curator of the museum and director of the meteorological observatory.

THE TORNADO IN HUDSON COUNTY, N. J., ON AUGUST 24, 1901.

By John H. Eadie, Voluntary Observer, Bayonne, N. J.

The cities of Bayonne, Jersey City, and Hoboken occupy the greater part of Hudson County, adjoining one another, in the order named from southwest to northeast. New York Bay and the southern end of Hudson River bound them on the east and Newark Bay bounds Bayonne and the southern end of Jersey City on the west. Through this section, what appears to have been a true tornado passed on the afternoon of August 24. The weather map for that day showed a receding high off the middle Atlantic coast, another high of quite large extent advancing over the Lake region, and a receding low over the mouth of the St. Lawrence River with an extension down the coast between the two highs. Quite heavy rain had been falling from early morning, with a moderate wind from southeast. Just before 4 p. m. the clouds became heavy and dark along the horizon from west to north and advanced with every indication of a squall from that quarter. A roaring of wind was heard, but not louder than that which often precedes a thunderstorm. The writer was to the southeast of the coming storm, and while no funnel was seen against the dark background, a tornadic wind advanced from Newark Bay and struck Bayonne opposite the foot of Thirty-sixth street, about 500 yards from the writer's home, and traveled in a northeasterly direction about 12 miles, accompanied by

[1] This instrument was purchased by Gen. A. J. Myer and exhibited for many years at the Signal Office in Washington. After having been stored away in the Smithsonian Institution it was transferred to the college in Cleveland.—Ed.

heavy rain. It was subsequently learned that the tornado first made its appearance at a small settlement known as Bloomfield on the west side of Staten Island about 2 miles from the lower end of Newark Bay, where it blew down and unroofed some barns and uprooted several large trees. It then apparently traveled up Newark Bay about 2½ miles and entered Bayonne as above stated. It did not do any extensive damage in Bayonne, but in the southern or Greenville section of Jersey City it destroyed some small frame buildings, severely injured a man and woman who occupied one of them, and totally destroyed a small frame church. The greatest damage done was in a thickly settled residential portion of Jersey City, where many dwellings lost roofs and chimneys. A large church had the greater part of its roof and side wall blown out; another lost its steeple; and the rear wall of a theater was blown out.

The entire path of the storm was narrow, apparently no where exceeding 500 feet in width. It skipped over many places lying in its course, but wherever it descended its action was fierce. The best evidence of its tornadic character was shown at Greenville, above mentioned, where it uprooted and broke off a number of trees within a space about 500 feet in diameter. These were located near the wrecked church referred to, in an apple orchard, and in the cemetery near by. The writer found these trees lying with their tops pointing toward the northeast, north, northwest, southwest and southeast, all in fairly regular order, the whirl of the wind apparently having been in a direction contrary to the motion of the hands of a watch laid on its back. Some of the larger trees were about two feet in diameter.

It has been estimated that the total loss caused by this visitation was in the neighborhood of $150,000.

While small storms of a similar character have occurred in recent years within a few miles of New York City, such as the Cherry Hill disaster in July, 1895, and the wrecking of several buildings in Elizabeth in August, 1899, no storm of equal destructive force and at the same time such narrow limits has ever been known to occur in Hudson County, or at any other place so near New York City, and for that reason it seems to deserve special mention.

RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau:

Popular Science Monthly. New York. Vol. 59.
McAdie, Alexander. Fog Studies on Mount Tamalpais. Pp. 535–541.
Ramsay, W. The Inert Constituents of the Atmosphere. Pp. 535–541.

Science. New York. Vol. 14.
Franklin, W. S. Weather Control. Pp. 496–497.

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Mill, Hugh Robert. Meteorology on the British Antarctic Expedition.
Curtis, R. H. On Thunderstorms. P. 128–130.
Fry, Isabel. Iridescent Clouds. P. 140.

Geographical Journal. London. Vol. 17.
—— The National Antarctic Expedition. Pp. 275–279.
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Bruce, William S. The German South Polar Expedition. Pp. 461–467.
Bidlingmaier, Fr. The Work and Equipment for Earth Magnetism and Meteorology of the German South Polar Expedition, and Suggestions for International Cooperation during the time of the South Polar Research, 1901–1903. Pp. 467–470.
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—— A Destructive Bolt of Lightning. P. 202.
—— Foster's Fog Signals. P. 200.

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Wren, H. B. Relations between Climate and Crops. Pp. 493–495.

Quarterly Journal Meteorological Society London. London. Vol. 27.
Mill, Hugh Robert. Climate and the Effects of Climate. Pp. 169–184.
Marriott, William. Special Characteristics of the Weather of March, 1901.
Strachan, Richard. Vapour-Tension in Relation to Wind. Pp. 197–198.
—— Lightning Research Committee. P. 184.
—— Cloud Observations at Toronto. Pp. 195–196.
—— Weather Forecasts by Wireless Telegraphy. P. 108.
—— A Feeding Storm. P. 198.
—— Crowing of Pheasants during Thunderstorms. P. 239.
—— Red Rain, March 10–11, 1901. P. 239.

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L., V. D. La distribution de la température au fond des mers. Pp. 343–346.
—— L'activité solaire de 1833 à 1900. Pp. 353–354.
—— Le climat Saharien. P. 356.

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Besson, L. Colonnes lumineuses des 26, 27, et 28 juin 1901. P. 235.
Ritter, Charles. Le nuage et son rôle dans la formation de la pluie. Pp. 203–234.
Maillet, E. Résumé des observations centralisées par le service hydrométrique du bassin de la Seine en 1899.

La Nature. Paris. 29me Année.
—— Pluie de Fourmis. Pp. 230–231.
Marey, E. J. Les mouvements de l'air étudiés par la chronophotographie. Pp. 232–234.
Stassano, Henri. Les aurores polaires. Pp. 235–236.
Laffargue, J. La télégraphie sans fil. Pp. 258–262.

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Carreras, Joaquin and Hernandez, Maurico. Observaciones meteorologicas efectuadas en Mahon, isla Menorca. 1865 à 1898. Pp. 623–626.

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Meinardus, Wilh. Der klimatologische Atlas des Russischen Reiches. Pp. 145–151.

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—— Verheerung durch einen Kugelblitz. P. 634.
—— Ein merkwürdiger Regen. P. 634.

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Polis, P. Die Temperatur-Umkehrung im Gebeite des Hohen Venns und der Eifel am 17 und 18 December 1900. Pp. 169–173.

Stade, Hermann. Die neunte allgemeine Versammlung der Deutschen Meteorologischen Gesellschaft zu Stuttgart am 1–3 April, 1901. Pp. 173–182.

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—— Bericht der Deutschen Seewarte über die Ergebnisse der magnetischen Beobachtungen in dem deutschen Küstengebiete und in den deutschen Schutzgebieten während des Jahres 1900. Pp. 404–408.

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Pernter, Josef Maria. Wetterschiessen in alten Zeiten. P. 372.

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THE SOLAR CONSTANT.

By FRANK W. VERY, dated September 9, 1901.

At the International Congress of Meteorology held at Paris in September, 1900, M. Violle, the Chairman of the Committee on Solar Radiation, expressed the hope that from the special discussion of this topic, now for the first time recognized as of sufficient importance to demand a place in the deliberations of a meteorological congress, a fresh impulse may be given to this study.

It begins to be recognized that the solar constant may, after all, be a variable with a considerable range, and if so, it is of great importance for meteorology, whether studied rationally for the sake of elucidating the causes of the changes of the weather, or as a practical art of weather forecasting, that a knowledge of the changes in this fundamental datum be obtained from day to day. The difficulties which supervene between the recognition of the importance of this knowledge and its attainment are enormous. M. Angot, at the close of the conference just named, expressed the fear that it may never, perhaps, be possible to arrive at an exact determination of this constant, and considered that at the present time effort must be directed toward perfecting actinometers and multiplying measures of the quantity of radiation which reaches the soil of the earth.

Against this rather disheartening conclusion may be placed the experience of Professor Angström, who, as the result of a comparison of his compensating and differential pyrheliometers, says: "The very satisfactory agreement in the values obtained from the two instruments, which are so different in principle and in their manipulation, speaks, as it seems to me, in favor of their accuracy." The problem of the perfecting of the actinometer, as an instrument capable of giving absolute values, seems to be at least approaching solution. It is rather by the devising of new methods of observation, and by new ways of interpreting and supplementing the results of measurements that further progress is to be made.

Crova's registering actinometer, checked by the indications of an absolute instrument, is capable of multiplying observations to any required extent, and Langley's bolographs give us a promising mode of interpreting results—in fact it is not too much to say that when these invaluable spectral records shall have been furnished under a greater variety of local conditions, carefully studied by the aid of meteorographs at high and low altitudes, and with simultaneous actinographs, checked by measures with a rapid absolute actinometer on Angström's or some equally efficacious plan, we shall have made a long step in the direction of an unimpeachable determination of the true intensity of solar radiation, and may possibly be able to decide the question of its variation at first hand.

The simultaneous occurrence of exceptionally hot weather over the North American and European continents in the summer of 1901, has provoked the conjecture that the sun itself is responsible for such wide-spread abnormal conditions; yet even if this were the case, it is certain that actinometers, read at the earth's surface in the heated zones, would not demonstrate such a solar hot wave, without a simultaneous thorough analysis of the condition of the upper air and the application of appropriate corrections. In fact, the first effect of an unusual increase of solar radiation must be to greatly magnify evaporation of moisture, both from the surface of the earth and from cloud layers, thus supplying the upper air with its most efficient absorbent of radiation. After this abundant replenishing with moisture, the incoming rays are employed to an unusual degree in heating the upper air, and increasing the altitude of the high-level isotherms. Surface temperatures rise because of this general lifting of the altitudinal isotherms, rather than by any immediate ac-

tion of the direct solar rays which possibly may even be lessened by the increased depth of the layer of especially absorbent material. The true radiation may easily be underrated while such conditions prevail. The change of conditions of the upper air affects the interpretation and correction of the observation for atmospheric absorption, perhaps, to a greater degree than it does the direct reading of the actinometer.

Allusion has been made to similar wide-spread meteorological conditions. It may be urged that world-wide changes of temperature or rainfall are connected with variations in the general movement of the atmosphere dependent upon a shifting of what M. Teisserenc de Bort has named the "centers of action" from which lesser movements are controlled, and that simultaneous and concordant temperature-changes over wide areas should be attributed to this cause in the absence of direct evidence of solar change; but as it is possible that the shifting of the centers of action may itself be due to some change in the general state of the air, inaugurated by solar fluctuations, no definite answer can be given to such questions until they can be treated as parts of a whole.[1]

A consideration of the mutual connection of related constants and physical properties has led me to a mode of testing several hypotheses, which will be described further on. In some such way it may be possible to meet the difficulties which seemed so insuperable to M. Angot.

Although we may have the choice of several instruments and methods which are nearly equally good, there are others which ought to be rejected, and especially those whose theory is too complex for practical use. Among the latter may be mentioned the steam calorimeter of Mr. J. Y. Buchanan, with which in May, 1882, under the rays of a nearly zenithal sun, in the phenomenally dry climate of Egypt, with a dew-point little above the freezing point and an atmospheric transparency which is sufficiently shown by the measured diurnal range of temperature of 44.5° F., the low value of 0.89 small calories per square centimeter per minute was obtained for the effect of solar radiation, to which the inventor, apparently for no well-defined reason, proposes to "add 11 per cent for deficiencies from all sources." In this apparatus the upper part of the condenser was not only exposed freely to air currents, but was in direct metallic connection with extensive surfaces of metal forming the condensing mirror. The loss of heat by convection from all these exposed and conducting surfaces must have been great. It was found, in fact, that wind greatly diminished the measured heat.

The elaborate experiments on Mouchot's solar steam calorimeter, as modified by Pifre, conducted at Montpellier in 1881 by a commission headed by M. Crova, indicated that this device, which is probably quite as effective as Mr. Buchanan's, utilized but little over 50 per cent of the sun's rays. The solar motor recently completed by Mr. A. G. Eneas of Boston, appears to be a notable advance upon its predecessors, but the theory of these instruments is as complex as that of the steam engine, and does not lend itself readily to determinations demanding minute accuracy.

The Arago-Davy conjugate black and bright bulb thermometers, whose mathematical theory has been worked out by Ferrel (see Professional Papers of the Signal Service, No. 13), but with very scant appreciation of the actual complexity of the absorptive process and its variation with the different kinds of radiation present, confounds effects which need to be kept separate, and is another example of that excessive complication which is to be avoided in a reliable working instrument. In 1883 Prof. Winslow Upton made a determination of the solar constant at Caroline Island by the conjugate thermometers in accordance with Ferrel's prescript,[2] but for the reasons given the value obtained can not be accepted.

The student who desires to follow the steady progress that has been made in this department should consult a valuable little work by M. Radau, Actinometrie, published by Gauthier-Villars at Paris in 1877, which gives a concise and clear account of what had been accomplished at that date. It is there recognized, on the strength of the experiments of Jamin and Masson on the transmission of radiation by colored glasses, that there is an exact proportionality between the luminous and thermal effects of simple or homogeneous rays. But a like proportionality does not hold for rays of different wave-lengths, and while luminous effects may be regarded as dependent on a certain photo-chemical action upon the retina, not all photo-chemical processes are equally definite and measurable. As M. Radau says (loc. cit., page 11): "The red rays and the yellow rays in certain cases continue the work commenced by the violet rays, and in others undo what the last have accomplished. Thus chloride of silver, slightly impressed by the violet rays, is then blackened under the action of all of the visible rays; and guaiacum, turned blue by the violet rays, is bleached by the more luminous rays. It follows that the chemical action of light is, in general, very complex, and that it can be used for measuring the energy of solar rays only with much circumspection."

M. J. Vallot and Mme. Gabrielle Vallot arrive at a similar conclusion in their "Experiments in chemical actinometry executed simultaneously at different altitudes and at diverse temperatures" in the Alps in 1897 (Annales de l'Observatoire Météorologique du Mont Blanc, vol. 3, page 81, 1898). The reaction consists in the decomposition of a solution containing 3 grams of oxalic acid per liter of water with evolution of carbon dioxid, when exposed to the sun's rays in a shallow dish. M. Duclaux, to whom the method is due, had found that heat alone produces only a negligible decomposition; that the reaction does not begin immediately upon exposure, and undergoes continued acceleration as insolation is prolonged; also that the decomposition is greater in August and September than in October on the clearest days. M. and Mme. Vallot, on repeating and extending these experiments, find that the evolution of CO_2 increases from three to five times when the mean temperature of the liquid is raised from 20.5° C. to 32.4° C. Hence, while heat alone can not start the action, it can greatly accelerate the decomposition by light, and in this respect the reaction resembles that which takes place in growing plants under the action of sunlight, where the organic development depends, other things being equal, upon a quantity proportional to temperature and illumination combined. No direct experiments were made to determine the region of the spectrum where the actinic power to decompose oxalic acid resides, save the observation of a strong obstruction by glass; but an increase of over 100 per cent was found for an ascent of 830 meters, from 1,095 meters to 1,925 meters, and an increase of over 400 per cent in the first part of August over the result for the last part of September, with equal duration of exposure, which may be partly induced by a higher temperature of the liquid in August and under the more powerful radiation of the higher altitude.

It is obvious that chemical actinometers are entirely without value for the determination of the solar constant, but they may have a use in estimating an integrated radiant and thermal function on which the growth of plants largely depends.

As M. Radau says (loc. cit., p. 9), all of the rays of the solar spectrum, whether belonging to the visible, the infra-red, or the ultra-violet regions, "are more or less warm [or

[1] See my paper on "The variation of solar radiation," Astrophysical Jour., vol. 7, p. 255, 1898.

[2] See Report of the Eclipse Expedition to Caroline Island, May, 1883, Memoirs of the National Academy of Science, Vol. II, p. 81.

rather calorific] and produce more or less pronounced chemical effects; but practically it is always a limited region of the spectrum which produces the observed effect."

In photography it is very evident that the rays absorbed by the film, and usefully employed in producing chemical change, are confined to narrow spectral regions. It is less obvious that a substance like lampblack, which, in a comparatively thin layer, absorbs almost totally the rays of the ultra-violet and visible spectra, and also a large part of the infra-red, has its limitations as an absorbent in like manner; but the discovery of extreme infra-red rays having a wave-length (at the rock-salt maximum) of at least 50 microns, and requiring special means for its absorption and measurement, has emphasized Melloni's observation that, for radiation from sources of low temperature and from such bodies as rock-salt, lampblack behaves as a partially transparent body. While the transformation of radiation into heat by black bodies and the registration of this heat by some thermometric device is more complete than any other action depending on radiant absorption, it is necessary, therefore, to remember that there is no universal or absolute absorbent. To guard against error from this source and enable radiation of a wider range of wave-length to record itself more completely, Paschen has devised an instrument for measuring radiation in which the thermometric surface (of thermopile or bolometer), being prepared with successive coats of platinum black and lampblack to increase its absorption, is placed at the center of a hemispherical mirror which returns the rays, entering by a central aperture and diffusively reflected from the partially absorbent surface, repeatedly to that surface, whereby an increasing percentage of the residual radiation is transformed into heat at each return to the blackened surface.[3] In this way a very close approach to the ideal absolutely black body is obtained, and a notable increase in the calorific power of extremely long ether-waves is recorded. For the direct actinometric measurement of solar radiation the method has little application, since the greater part of the solar radiant energy resides within the region for which absorption by lampblack is almost complete; but for the indirect estimation of the solar radiant energy outside the atmosphere, it is very desirable that spectral energy-curves shall be obtained in their true forms, and this, for the first time, can now be accomplished by the aid of Paschen's repeating bolometer.

M. Radau has the merit of having perceived the usefulness of spectroscopic measures in the determination of the solar constant. "The formula, $I = A p^{\varepsilon}$, applies to a bundle of homogeneous rays. The intensity of the total radiation of the sun, transmitted by the atmosphere, ought to be expressed by a series of terms each relating to a particular bundle [or kind of radiation, whence]

$$I = A p^{\varepsilon} + A_1 p_1^{\varepsilon} + \ldots,$$

the primitive intensity being the sum, $A + A_1 + \ldots$ When the thickness ε does not vary much, the observations are ordinarily represented with quite sufficient precision by the formula with a single term, $I = A p^{\varepsilon}$, by taking a mean value for p; but when the sun approaches the horizon a single term no longer suffices for the calculation of the observations. The mean value of p increases greatly when ε becomes very large, because the terms of the complete formula, where the coefficients p are small, disappear little by little, so that there remain only terms whose coefficients are near unity. Hence, by contenting ourselves with a single term, we find for p values so much the greater as the measures have been made nearer the horizon. This is, in fact, what the observations of Forbes, of Quetelet, and of Desains have confirmed. The coefficient [of transmission] p increases, and a [which in Radau's equations signifies the logarithmic coefficient of absorption] diminishes in proportion to the growth of ε; that is to say, the solar radiation becomes *more transmissible* as it traverses larger masses of air, because it is deprived little by little of the more absorbable rays" (loc cit., p. 24).

[3] F. Paschen. Sitzungsberichte der Akad. der Wissenschaften zu Berlin, 1899, part 1, p. 405; Astrophysical Jour., vol. 10, p. 40, 1899.

But while the real nature of the problem was pointed out in these words, no one attempted to apply them until Langley made his memorable expedition to Mount Whitney (see Professional Papers of the Signal Service, No. 15) and began the detailed investigation of the infra-red spectrum, obtaining, in his Researches on Solar Heat, coefficients of atmospheric transmission for a small number of points in the spectrum within the range of a glass prism, and applying this knowledge in a redetermination of the solar constant, whose reliability remains unapproached by any other measurement, for, with the exception of Angström, no one has attempted to follow up the advantage gained by this new mode of attack.

By these earlier spectrobolometric researches, Langley established the distinction between two different kinds of selective depletion which the solar rays suffer in traversing the earth's atmosphere. One kind is greatest for the rays of shorter wave-length and diminishes by perfectly regular gradations as we pass toward the longer waves of the infra-red. Its cause may be referred to selective reflection or diffraction of the shorter ether-waves by particles of excessive minuteness. The other kind of absorption produces irregular gaps or depressions in the spectral energy-curve, which begin at the red end of the visible spectrum and grow in magnitude and frequency as the wave-length increases. Researches by Abney and Festing, and by other investigators, have traced the majority of these depressions to the action of aqueous vapor.

The use of rock-salt prisms has since greatly extended this new infra-red region, showing a further increase in the number and intensity of these aqueous absorption bands, until they coalesce in a great region of almost total absorption between 5μ and 8μ, first depicted in the memoir on The Solar and the Lunar Spectrum, communicated by Langley to the National Academy of Science in 1886, and printed in its Memoirs, Volume IV. Beyond this region of intense absorption the air again becomes transparent, but as these extreme rays have little importance for absolute measurements of solar energy, it is sufficient to describe the two principal sorts of telluric absorption which affect the solar spectrum as increasing in opposite directions, leaving a middle region of the spectrum comparatively unaffected.

In the recently published Annals of the Astrophysical Observatory of the Smithsonian Institution (vol. 1, 1900, by S. P. Langley, Director, aided by C. G. Abbot), Langley, in describing his earlier paper of 1883 on "The selective absorption of solar energy," says: "These measurements confirmed the earlier conclusion that the maximum ordinate of the normal energy-curve was in the orange, and showed that the absorption of the earth's atmosphere [by selective scattering] increased rapidly with *decreasing* wave-lengths, then a novel statement, for, strange as it may now appear, it was even at this late time very generally supposed to increase most in the lower red, though the simple aspect of a sunset might have taught the contrary" (Annals, p. 11). In order to do fuller justice to earlier investigations, I would remark that in 1869 Tyndall, completing the imperfect conjectures of his predecessors, had found the cause of the blue color and the polarization of the light of the sky in selective reflection from fine particles. His explanation had been generally accepted. Clausius had shown that for a solar altitude of 10° the light diffused by the sky was more than double that coming directly from the sun. Lord Rayleigh had given in 1871 a mathematical expression for the intensity of homo-

geneous rays of wave-length λ, whose initial magnitude I_0, after transmission through a turbid medium of thickness ε, becomes:

$$I = I_0\, e^{-k\lambda^{-4}\varepsilon}.$$

This formula, with suitable values of k, is capable of representing the observed changes, due to generally selective reflection, which result according to subsequent measures. M. Radau, in 1877, says (Actinometrie, p. 101): "The coefficient of transparency is more feeble for the rays belonging to the violet region of the spectrum and for the dark chemical rays, as it is also very feeble for the dark [infra-red radiant] heat," thus recognizing a middle region of the solar spectrum more transmissible than the ends, which accords with the facts.

It is true that statements can be found in which the telluric absorption is described as greatest at the red end of the visible spectrum, meaning, of course, the atmospheric band absorption which becomes pronounced in the spectrum of the sky, after sundown; but such statements are but analogous to some passages in these Annals which require mutual interpretation. For example, in the summary, p. IV, we read: "The infra-red region is shown to be the seat of the principal telluric absorption of the solar energy," and in the summary in Chapter VIII, p. 216, "the infra-red is the seat of great terrestrial atmospheric absorption," while on page 11 we find that "the loss in passing through the atmosphere was chiefly confined to the shorter wave-lengths," and on page 14, we learn that "in spite of these absorption bands, the principal portion of infra-red solar energy is transmitted more freely than the visible." (See also page 208.) These apparently conflicting statements may easily puzzle a novice. The discrepancy is partly due to an imperfect characterization of the two leading kinds of absorption. To complete the idea something must be supplied from the context. Besides this, there is a different use of the term *absorption*, which represents in the first place a percentage ratio whose distribution in the spectrum may be considered apart from the actual intensity of the radiation, but which may also represent the amount of energy which has disappeared. The "principal portion" of solar infra-red energy lies outside the region of the *principal infra-red absorption* in the first sense of the word. Hence, while the solar rays suffer their greatest percentage of telluric absorption through extensive regions in the extreme infra-red, the larger portion of solar infra-red rays lies outside the bands, and is rather freely transmitted.

On page 205, and again on page 214 of the Annals, doubt is thrown on a "suspicion" that the bands $\rho\ \sigma\ \tau$, and Φ are telluric, as "has been affirmed of them by Abney" (Proceedings of the Royal Society of London, vol. 35, p. 80, 1883); and on page 216 of the Annals, in speaking of the absorption exercised by layers of 6 millimeters, and of 13 millimeters of water, it is said: "It appears certain that the band Φ is not due to water or water vapor. The absorption of water begins just at the long-wave side of Φ, is moderate up to Ψ, very great for a strip about 2′ wide on the long-wave side of Ψ, moderate between Ψ and Ω, but still greater than between Φ and Ψ, very great for a little distance below Ω, and very considerable from here on." The attentive reader will, of course, recall the complete demonstration by Abney and Festing (Proceedings Royal Society of London, vol. 35, p. 328, 1883), that not only the bands in question, but also four others of shorter wave-length, are of aqueous origin. Much greater depths of water, up to 24 inches, were used by these experimenters. The bands $\rho\ \sigma\ \tau$ and Φ are perceptible in the spectrum after absorption by only $\frac{1}{8}$ inch of water, but do not become pronounced until a much greater depth is passed.

In my memoir on Atmospheric Radiation (Bulletin G, United States Weather Bureau, p. 104, 1900), I have computed the percentage transmissions from the curves given by Abney and Festing, obtaining for a layer of $1\frac{3}{4}$ inches of water:

	Transmission. Per cent.
At the rain band in the yellow	91
Maximum in orange-yellow	98
Orange band due to water	88
Maximum in red	96
Red band (near A) due to water	88
Maximum near Brewster's Y	90
Band between X and Y, due to water	85
Maximum (Herschel's α)	87
Band (Abney's $\rho\ \sigma\ \tau$) due to water	19
Maximum (Herschel's β)	33
Band (Abney's Φ) due to water	2
Maximum (Herschel's γ)	8

All beyond the maximum between Φ and Ψ is totally absorbed by this depth of water.

Paschen, in 1894 (Wied Ann., vol. 51, p. 22), noted that the absorption bands of liquid water, while beginning at the same points as those due to aqueous vapor, are broader on the side of greater wave-length; and Abney and Festing have shown the existence of two kinds of absorption bands in the solar infra-red spectrum (linear and diffuse), which I have suggested, may be attributed to diverse molecular states of water vapor, connected with variations in relative humidity. (See Atmospheric Radiation, pp. 90–105.) In view of these facts it becomes necessary to include both tension of aqueous vapor and relative humidity in the expressions that represent the absorptive influence of the aqueous component of atmospheric absorption, as well as the complex λ-function on which the local band variations depend.

If, with Lord Rayleigh, we attribute the blue color of a sky, entirely free from haze, to the diffraction of the gaseous molecules, it may be necessary also to divide the expression for selective scattering into two parts: one to include molecular action, in which ε varies with the path of the rays (computed by Laplace's formula) and with the barometric pressure; the other due to atmospheric dust of the finest sort, which ordinarily only ascends to a height of 4 or 5 kilometers, which is independent of the barometric pressure, and for which ε' had best be computed by Lambert's formula:

$$\varepsilon' = \sqrt{1 + 2r + r^2 \cos^2 \zeta} - r \cos \zeta,$$

in which r has some such value as 5 kilometers, depending on the height of the upper limit of the dust layer.

ζ	ε' (dust.)	ε (air.)	ζ	ε' (dust.)	ε (air.)
°			°		
10	1.013	1.016	60	1.653	1.995
20	1.053	1.065	70	2.021	2.902
30	1.124	1.156	80	2.560	5.571
40	1.236	1.306	85	2.909	10.216
50	1.405	1.555	90	3.317	35.503

To this must be added the indiscriminate or nonselective scattering of rays without much regard to wave-length, which is chiefly accomplished by the coarser ice or water particles of the clouds, for which no law can be formulated, and which must be eliminated by confining our observations to the clearest days.

As to the absorption of solar rays by carbon dioxid, Prof. Knut Angström, in his recent paper "On the importance of water vapor and carbon dioxid in the absorption by the earth's atmosphere" (Ann. der Phys. (4), vol. 3, p. 720, 1900), concludes that the air contains enough of this gas to produce complete absorption within the limits of its bands. Consequently this absorption is best expressed by a constant, graphically estimated from a restored spectral energy-curve.

In the words of Violle: "We must therefore henceforward

entirely renounce the 'barbarous' expression, to use Dr. Pernter's phrase, of a single coefficient of transparency relative to the action of our atmosphere on the total radiation of the sun. But after the results of the researches carried out or suggested by Langley, how complicated does this absorption appear!"

We may consequently pass by the numerous formulæ which attempt to find the solar constant with only one, or at most, two terms. Such formulæ may represent actinometric values obtained within a limited range of conditions quite perfectly, but can not be extended much beyond that range. Pouillet, from the close concordance of his results obtained by using a simple formula and an instrument having large constant errors, felicitated himself on having arrived at such an exact value of the solar constant that he could be permitted to draw improbable conclusions in regard to the temperature of space; and in the Annales de l'Observatoire Météorologique de Mont Blanc (vol. 2, 1896), we find M. J. Vallot resting in the same fatuous security, and adopting for the solar constant 1.7 small calories per square centimeter per minute from the mean of four series having an extreme variation of 2 per cent, with the remark: "This concordance of results authorizes us to believe that those which we give depart little from the truth" (page 147). M. Radau (Actinometrie, p. 29) has shown that as long as we are contented with an apparent concordance of a few per cent, the mean results of our actinometric observations through a limited range can be represented by a great variety of empirical formulæ; and he notes that "the only useful formulæ are those whose constants admit of a physical interpretation." Langley (Researches on Solar Heat, p. 45) remarks that "in solar actinometry, the mean of all our observations is never really the most probable, and the true value is always, and necessarily, higher than this mean;" and in Chapter X of the same work he proves that "the error increases with the difference between the coefficients" of transmission for different rays, when these are not discriminated, and that apparently concordant results, obtained by the application of such simple formulæ as that of Pouillet, are grossly erroneous.

Notwithstanding these demonstrations, the devising of simple empirical formulæ continues with, perhaps, little use, save as ingenious mathematical exercises. The reader who cares to follow these developments will find a succinct account of many such formulæ in the Report on Radiation, by M. Jules Violle, in the Report of the Proceedings of the meeting of the International Meteorological Committee at St. Petersburg, September, 1899, under the heading "Formulæ" (p. 60).

As an example of the fallacies which lurk in such formulæ, we may notice one proposed by Angström in 1899, but which was subsequently completely demolished by his own investigations. Dividing the solar radiation into two parts: A_1 composed of rays affected by the absorption through aqueous vapor, oxygen, and nitrogen; A_2 consisting of rays absorbed by carbon dioxid; p_1 and p_2 being the corresponding coefficients of transmission, the observed intensity of solar radiation is represented by the formula:

$$Q = A_1 p_1^{\epsilon} + A_2 p_2^{\epsilon}.$$

Assuming that the rays capable of being absorbed by CO_2 have completely disappeared for values of ϵ greater than 3 atmospheres, the values:

$$A_1 = 1.56, \; p_1 = 0.786,$$

are first obtained by the one-term formula applied to low-sun observations. Then, subtracting the values computed by the formula, $Q_1 = 1.56 \times (0.786)^{\epsilon}$, from the results of observation in six other cases where ϵ varies between 2.26 and 1.26, and adopting a mean coefficient for the rays absorbable by CO_2, viz: $p_2 = 0.134$, derived from his own observations, combined with others by Lecher (but which, as it appears from later measures, contain large errors), Angström obtains from the residuals, $A_2 = 2.45$, whence the solar constant becomes:

$$A_1 + A_2 = 1.56 + 2.45 = 4.01.$$

In regard to this method, I have remarked (Atmospheric Radiation, p. 105) that it "leads to the absurd result that over 60 per cent of the original solar radiation is contained in the spectral region occupied by the bands of carbon dioxid. The limits of these bands have now been ascertained, and it is certain that they do not cover a length of the solar spectrum possessing more than a small fraction of this proportion of total radiant energy," and that it is inadmissible to raise the solar constant to 4 calories *on these grounds*. It is only fair to state that this has since been independently recognized by Professor Angström himself.

M. Vallot, as already stated, observing on Mount Blanc with a Violle actinometer, computes a value of 1.7 for the solar constant, which is less than has been obtained directly for the solar radiation, *after absorption*, by reliable measures at high elevations.

As all of M. Vallot's observations have been made with positive values of θ (the excess of the sun thermometer), it is necessary to add a correction (A) for losses by convection. It would be much better to conduct measures with the Violle actinometer, so that there shall be approximately equal positive and negative values of θ, which, when combined, will obviate the need of this correction.

Another important correction which has not been applied is that for the imperfect conductivity of mercury (B), and a determination of the errors due to imperfect absorption is desirable. In the following table, I have applied corrections (A) and (B) to Vallot's measurements. The corrections for imperfect absorption by the surface of the thermometer bulb (positive) and for radiation reflected by the sky around the sun (negative) are not known. The first is no doubt larger than the second, hence the corrected values will still be a little too small. Following Langley,

$$\text{Correction } (A) = + \frac{H}{760} \times 14.3\,\%.$$

$$\text{Correction } (B) = + \cos \tfrac{1}{2} \zeta \times 8.3\,\%.$$

Station: Mount Blanc.						Station: Chamonix.					
Time.	ζ	$\frac{H}{760} \times \epsilon$.	I obs.	Cor.	I cor.	Time.	ζ	$\frac{H}{760} \times \epsilon$.	I obs.	Cor.	I cor.
h. m.	° ′	Atm.	Cal.	Cal.	Cal.	h. m.	° ′	Atm.	Cal.	Cal.	Cal.
5 31	81 45	3.890	0.980	+.141	1.121	......	.....	......	......	......	......
7 40	59 5	1.105	1 428	+.218	1.646	7 26	62 0	1.912	1.080	+.214	1.294
9 20	42 56	0.768	1.458	+.230	1.688	9 14	43 46	1.224	1.198	+.244	1.442
1 14	31 14	0.655	1.565	+.252	1.817	1 34	33 30	1.064	1.287	+.266	1.553

The precipitable water above the summit is supposed to have been 1.7 millimeters; that above the lower station, 25 millimeters.

These results may be compared with the following, obtained by Langley's expedition to Mount Whitney, also made with Violle's actinometer (corrections applied):

Station: Mountain Camp.			Station: Lone Pine.		
ζ	$\frac{H}{760} \times \epsilon$.	I.	ζ	$\frac{H}{760} \times \epsilon$.	I.
° ′	Atm.	Cal.	° ′	Atm.	Cal.
66 56	1.675 (a.m.)	1.554	70 33	2.600 (a.m.)	1.441
62 9	1.411 (a.m.)	1.752	66 56	2.216 (p.m.)	1.355
60 58	1.358 (p.m.)	1.617	64 33	2.024 (a.m.)	1.571
26 38	0.738	1.882	60 58	1.797 (p.m.)	1.423
26 7	0.734	1.909	26 38	0.976	1.696
(Peak) =	[0.655]	[1.954]	26 7	0.972	1.718

The larger values of solar radiation on Mount Whitney are no doubt due to the extreme dryness of the air. The altitude of the peak of Mount Whitney (4,460 meters) is somewhat less than that of Mount Blanc (4,810 meters), and Lone Pine Camp (1,184 meters) is a little higher than Chamonix (1,040 meters); but the temperature in the middle of the day in July amid the snows of Mount Blanc was several degrees below freezing point, and the aqueous vapor was nearly saturated, whereas in the final measurement at the peak of Mount Whitney the air temperature was + 16.9° C.; moreover, as an observation with Regnault's hygrometer on another occasion gave a dew-point of —12.5° C., while the mean dew-point by psychrometer (September 1–3) was — 11.6° C., it is quite likely that the air immediately above Mount Whitney was nearly dry, since the observed dew-point would give a relative humidity of only 12 per cent. Even so small an amount of moisture as this, however, is able to exert a large absorption on radiation which has not been depleted of the rays falling within the limits of the aqueous bands, and M. Vallot's assumption that the aqueous absorption is proportional to the amount of aqueous vapor penetrated by the rays, is far from correct. Moreover, any approach to saturation of the aqueous vapor brings out the diffuse absorption bands peculiar to complex aqueous molecules, and adds still more to the losses produced by this ingredient of the atmosphere. It is for these reasons that M. Violle's formula for the solar constant,

$$I = A\,p^{\left[\frac{H+(Z-z)kf}{760}\times\epsilon\right]},$$

fails. In fact, k, by which the force of vapor (f) is to be multiplied, can not be a constant, nor is the aqueous absorption proportional to $Z - z$, the depth of the moisture-holding layer of the atmosphere above the place of observation.

By entirely rejecting his low-sun observation, not because it is too small, and therefore to be suspected of failing from interference of the mists near the horizon, as happens in too many cases with a low sun, but because it is too large and disagrees with preconceptions founded on an empirical formula, M. Vallot is able to compel his remaining data to fit Violle's supposed law. It is quite unnecessary to pay any further attention to the value of A thus deduced; but the original measurements, with the proper corrections, are worth preserving.

Dr. G. B. Rizzo, in his memoir on the solar constant (Accad. Reale d. Sci. di Torino (2), vol. 48, p. 319, 1898), besides giving a series of actinometric measures made by himself and assistants on Rocciamelone, resulting in reduced zenithal values of 1.61 calories at an elevation of 501 meters, 1.98 calories at 1,722 meters, 2.09 calories at 2,834 meters, and 2.13 calories at 3,537 meters, has recomputed the spectrobolometric measures made by Langley at Mount Whitney, using an empirical formula:

$$Q_\lambda = \frac{A_\lambda}{(1+\epsilon)^m},$$

where A_λ is the value of the original homogeneous radiation of wave-length λ, Q_λ is the same after passing air mass ϵ, and m is a constant, best satisfying the high and low-sun observations. The formula is derived from that used by Crova in reducing his actinometric measures, and gives an outside curve with the maximum at 0.5 μ. The principal advantage of this formula is that it allows us to express the observed fact that the coefficient of transmission,

$$p = \left(\frac{1+\epsilon_1}{1+\epsilon_2}\right)^m,$$

increases with low altitude of the sun. It does not eliminate inconsistencies. Thus, some of the values of A_λ, obtained from mountain and valley observations, differ by over 100 per cent. Dr. Rizzo, in fact, only uses the formula to obtain values of $Q_{1\lambda}$ for $\epsilon = 1$, which he then transfers to a barometric formula:

$$Q_1 = A + B\,(760 - H)^{\frac{1}{2}}.$$

No improvement is affected by this method, which gives altogether too little absorption in the ultra-violet, yet there can be no doubt that these valuable measures are capable of yielding improved results, if treated by a rational theory.

The spectral region covered extends from 0.35 μ to 1.2 μ in the grating spectrum, and is chiefly affected in passing through the atmosphere by selective scattering of the rays from fine particles. The infra-red region beyond 1.2 μ is mainly influenced by band absorption, due to aqueous vapor and carbon dioxid. As a first approximation, let us assume that the two regions are, on the whole, equally depleted, each by its own peculiar process of degradation, and that the total energy of either region, as measured at the two stations, may be approximately equalized to the ratio of actinometric measurements.

Lord Rayleigh's later formula for diffraction from the air molecules (Phil. Mag. (5), vol. 47, p. 375, 1899) gives a smaller residual from observation in the visible and ultra-violet spectrum, but one which is less regular than that deduced by his formula of 1871 (Phil. Mag. (4), vol. 41, p. 107):

$$[\mathrm{R}] \qquad I = I_0 \times e^{-k\lambda^{-4}\epsilon},$$

I_0 and I being intensities outside and inside the atmosphere, e the basis of natural logarithms, k a constant depending on the properties of the fine particles, λ the wave-length of the homogeneous rays, and ϵ the air mass. I shall assume that this equation represents the diffraction by air molecules, and that the value of k is 0.01. The air mass (ϵ) is given in atmospheres, the barometric pressure and the length of path (as given by Laplace's formula) are included in it.

The reflection from even the finest atmospheric dust, whose particles much exceed molecular dimensions, is only moderately selective, and the exponent of λ can not greatly surpass unity. I shall adopt Lord Rayleigh's earlier formula, with the subtitution of $\lambda^{-1.5}$ for λ^{-4} to express the depletion of the rays by atmospheric dust:

$$[\mathrm{D}] \qquad I = I_0 \times e^{-k'\lambda^{-1.5}\epsilon'},$$

The value of k' will depend on the amount of dust in the air. A dense haze or smoke, giving a blood-red sun, lets only 2 or 3 per cent of red light pass, although I have found over 50 per cent of infra-red radiation transmitted under these circumstances. Here k' may be taken equal to 2.0. At the Mountain Camp, Mount Whitney, Langley found the atmospheric dust much diminished (Researches on Solar Heat, p. 41). We may take k'=0.125 for this condition, and k'=0.25 for the dust constant at Lone Pine. The dust layer is assumed to ascend to a height (r) of 2 kilometers above the upper station, and 5 kilometers above the lower station, and the value of ϵ', which in this case does not depend upon barometric pressure, is to be computed by Lambert's formula.

The noon values of the spectral energy-curves are taken from the table on page 189 (Researches), in accordance with the footnote on page 137, and the explanation on page 188.

Mount Whitney ...	ζ = 29° 21′,	ϵ = 0.753,	ϵ' = 1.09.
Lone Pine	22° 38′,	0.943,	1.07.

The transmissions through the given masses for air molecules (R) and for dust (D) are given, together with the observed values of I and the computed values of I_0 in the following table:

λ	Mount Whitney.				Lone Pine.			
μ	R	D	I	I_0	R	D	I	I_0
0.35	.6055	.5180	43.1	137.4	.5335	.2747	25.1	171.3
0.375	.6833	.5525	47.3	125.3	.6207	.3111	28.4	147.1
0.40	.7452	.5836	77.2	177.5	.6920	.3474	50.1	208.4
0.45	.8324	.6368	187.8	354.3	.7943	.4122	110.6	337.8
0.50	.8865	.6803	246.9	409.4	.8600	.4692	153.9	381.3
0.60	.9436	.7459	269.3	382.6	.9298	.5623	201.0	384.4
0.70	.9692	.7925	231.6	301.5	.9614	.6333	191.1	313.9
0.80	.9817	.8266	172.0	211.9	.9772	.6882	155.5	231.2
1.00	.9927	.8724	108.2	124.9	.9906	.7652	100.2	132.2
1.20	.9963	.9016	77.8	86.6	.9954	.8158	76.4	94.1

The aberrant ultra-violet values for $\lambda = 0.35\ \mu$ are probably illusory, as the impure spectrum is liable to contain at this point much stray light from the hotter regions near the maximum. Moreover, the necessary corrections for losses in reflection from metallic surfaces of mirrors and grating, form a relatively large part of the observed value in this region, increasing the chance of error. Hence, I have not retained these values in measuring the areas of the curves. The spectral energy-curves show maxima at the following points:

Outside,	$0.532\ \mu$
Mount Whitney,	$0.579\ \mu$
Lone Pine,	$0.632\ \mu$

and the areas of the curves to $1.2\ \mu$, rejecting the observations at $\lambda = 0.35\ \mu$, are:

λ	$\lambda=0.2$ to 0.3	$\lambda=0.3$ to 0.6	$\lambda=0.6$ to 0.9	$\lambda=0.9$ to 1.2	Total 0.2 to $1.2\ \mu$
Outside the atmosphere	0.4	41.2	40.5	17.9	100.0
Mount Whitney	0.0	23.9	30.6	15.2	69.7
Lone Pine	0.0	15.4	25.9	14.3	55.6

Additional loss by band absorption, chiefly between λ 0.6 and 1.2 (estimated from spectral energy-curves)	7.0
Transmission by curves (Mount Whitney)	62.7
Transmission by curves (Lone Pine)	48.6

By Violle actinometer (corrected), Mount Whitney radiation $= 1.896$
By pyrheliometer (mercury standard), Lone Pine radiation $= 1.533$

$$\text{Solar constant (Mount Whitney)}\ \frac{1.896}{0.627} = 3.024 \text{ cal.}$$

$$\text{Solar constant (Lone Pine)} \ldots\ldots \frac{1.533}{0.486} = 3.154 \text{ cal.}$$

These results indicate that k', which has been taken twice as great for the lower station as for the upper, should be slightly diminished for the lower station, since the reductions to mean solar distances are $+2.5$ per cent for Lone Pine, and $+1.6$ per cent for Mount Whitney.

If the assumption of equal total depletion for the regions above and below $1.2\ \mu$ were exact, these ratios would give for the solar constant 3.15 small calories per square centimeter per minute, or 0.0526 radim. But the aqueous absorption in the infra-red region must first be examined more critically.

The latest advances in the study of the invisible spectrum enable us to apply some rough tests. Scheiner, in his recent work, Strahlung und Temperatur der Sonne (p. 51), adopts 7,760 centigrade degrees on the absolute scale as a probable value of the solar photospheric temperature assuming unit emissive power, and 13,800° for an emission coefficient of $\frac{1}{10}$, although it is also shown that if the sun radiates according to Stefan's law for a black body, its effective temperature can not be much over 6,000°. Adopting Wien's law of radiation as modified by Paschen,

$$\log\,(I \times \lambda^5) = \log c_1 - c_2 \log e \times \frac{1}{\lambda T}$$

(where $c_1 = 633{,}000$, and $c_2 = 5 \times \lambda_{\text{max.}} \times T = 5 \times 2{,}891$, are constants, T is the absolute temperature, and I is the intensity of radiation of wave-length λ), if the sun radiates like an absolutely black body, and if a maximum occurs in the spectrum at $\lambda = 0.45\ \mu$ for the unabsorbed normal energy-curve of the spectrum from photospheric radiation, then this corresponds to a solar temperature of $T = 6{,}424°$. The energy-curve computed by the law just given, after reduction for the absorption by the solar and terrestrial atmospheres, agrees with observation between $\lambda = 0.3$ and $\lambda = 1.0\ \mu$, but departs more and more widely beyond the latter point, until at $9.0\ \mu$ the computed ordinates are only $\frac{1}{35}$ of the observed values at points of least absorption. Hence, it is certain, as Scheiner has noted, although without applying any numerical test, that the sun does not radiate like an absolutely black body. Moreover, it does not radiate at any single temperature, but the photosphere being composed, as Langley has shown (Am. Jour. Sci. (3), vol. 7, p. 87, 1874), of brilliant granules, having a high emissive power, and occupying only one-fifth of the surface, while the background formed by the remaining four-fifths is relatively dull, it follows that the total photospheric radiation is made up of the radiant emission from particles at very different depths, and having doubtless a wide range of actual and effective temperature. Hence, the unabsorbed spectral energy-curve must be the integration of many curves corresponding to many temperatures, and presumably none of them agreeing with that of the ideal black body. The result is to raise the ordinates (intensities) corresponding to the longer waves.

The theory, however, may still be used to supply an estimate of the solar curve before absorption by the earth's atmosphere, and hence of the solar constant, if we distribute its errors by a logarithmic curve which gives a spectral energy-curve similar to that enveloping the maxima of the observed solar prismatic curve. The observed intensity in the rock-salt prismatic spectrum at $1\ \mu$ is one hundred times as great as at $9\ \mu$ (37° 12′ minimum deviation)[4], and the transmissions for points of least absorption are about 0.82 and 0.88, respectively; but the intensities by Paschen's formula, reduced to the prismatic curve, are 58,006 and 16.4, or in the ratio of 3,537 to 1; and as probably no one would maintain that the absorption of the solar atmosphere is capable of producing such diversity, it seems proper to attribute the divergence from the energy-curve of a black body to some peculiarity in the emissive power of the solar substance. In the following table it is to be noted that the end values are given by experiment, and the intermediate ones are obtained by taking equal logarithmic corrections to the theoretical curve for equal differences of wave-length. A small correction is made at $1\ \mu$ to allow for band absorption. The remainder of the loss here may reasonably be assigned to selective scattering.

Wave length (μ)	1	2	3	4	9
Intensity (black body)	3537	2018	357	86.2	1
Logarithmic factor	.0240	.0372	.0575	.0891	.8000
Intensity (computed)	84.9	74.9	20.5	7.7	0.8
Envelope at maxima of solar curve	70	60	12	5	0.7

The values in the last line are for a curve tangent to the observed maxima and having a maximum ordinate of 100 between Ψ and Ω. Inserting the sinuosities from the bolographs obtained by Langley and Abbot, and completing the curve by the measures of solar radiation for long waves, the areas, measured by the planimeter, are:

	λ	Outside.	After absorption.
	$1.2 - 2.0\ \mu$	67.7	37.2
	$2.0 - 5.0$	25.8	12.4
	$5.0 - 15.0$	6.5	0.6
Total:	$1.2 - 15.0\ \mu$	100.0	50.2

The absorption in the infra-red varies so slowly with the increase of air mass, being produced almost wholly by the

[4] See "The solar and the lunar spectrum." By S. P. Langley, assisted by F. W. Very. Memoirs National Academy of Science, vol. 4, Second Memoir, Fig. 2 a.

upper air, that we may apply the value thus obtained from spectral measures at sea level to the Lone Pine observations, getting for the part of the spectrum beyond 1.2 μ[5] a transmission of 50.2 per cent, which agrees so nearly with that already deduced for the radiant energy of shorter wave-length than 1.2 μ, namely, 48.6 per cent, that the assumption of equal *average* absorption in the two regions seems justified. As thus reduced, the Mount Whitney observations yield the following values for the solar constant (reduced to sun's mean distance):

		Calories per sq. cm. per minute.
From Mountain Camp observation............		3.072
From Lone Pine observations.......	3.233 3.130	3.182
Mean		3.127

The agreement between values deduced from noon measures at high and low stations is satisfactory, and that for measures at high and low sun is equally good, or becomes so with only trifling modifications of the adopted constants. The separation of the coefficients for scattering of the rays by fine particles into air and dust factors is therefore justified.

It is commonly supposed that the larger portion of the heat produced by the absorption of the solar rays remains in the lower layers of the atmosphere, because these are richest in the vapor of water and in dust. See, for example, M. Crova's Mesure de l'intensité calorifique des radiations solaires et de leur absorption par l'atmosphère terrestre, p. 1, Paris, 1876. M. Radau, Actinometrie, p. 12, says: "In proportion as the rays penetrate into the atmosphere, they encounter layers more and more dense, and the loss which they experience through unit path is proportional: (1) to the actual intensity of the beam; (2) to the density of the layer which they traverse; (3) to a constant coefficient of absorption . . . which varies with the nature of the rays." On page 14 (loc. cit.) it is said that "the absorption is due in great part to the vapor of water distributed in the lower layers of the atmosphere," although it is recognized (page 18) from the observations of Desains, that the ratio of long-waved solar radiations on a high mountain to those at sea level must diminish when the air is very moist. Nevertheless, no objection is made to the use of formulæ in which the aqueous component of the absorption is assumed to be proportional to the density of the aqueous vapor.

The actual case is much more complicated. Selective reflection increases in the lower atmospheric layers, but does not warm them. Low layers of a moist atmosphere become hot because they absorb the rays of extremely long wave-length emitted by the heated soil. The sun heats these layers indirectly by first heating the ground, but contributes little heat directly, since the rays absorbable by aqueous vapor have been nearly all sifted out of the sunbeam before this reaches the lower atmospheric layers. On the other hand, the higher atmosphere, which contains a smaller quantity of aqueous vapor, is the first to attack the incoming rays. It is in the upper layers that the aqueous absorption of the solar infra-red rays takes place chiefly, and these are therefore the layers which are most warmed by the direct rays of the sun. I have noted elsewhere (Atmospheric Radiation, p. 123) that after rising above the comparatively thin layer of convectionally heated air, that portion of the diurnal range of temperature due to the immediate absorption of the solar rays may be expected to increase up to nearly the limit of the aqueous atmosphere, and it is surmised that this variation may possibly approach a ten-fold ratio of that which occurs at altitudes of one or two kilometers.

Professor Bigelow (Report on the International Cloud Observations, United States Weather Bureau, 1898–99, p. 786,) finds that "the number of calories per kilogram required to transform the adiabatic state into the actual state of the atmosphere," as inferred from cloud phenomena, and to some extent confirmed by the results of balloon ascensions, varies from 1 or 2 calories, at the height of 1,000 meters, to 10 or 11 calories, at an altitude of 13,000 meters. This phenomenon, it seems to me, is attributable to the direct solar influence upon the higher layers of the air. The annual range of temperature of the upper air has also been found to be unexpectedly large, a fact which must follow from the present argument, but which has not been heretofore anticipated, because of the erroneous conception that the sun's rays are but little absorbed by the upper air.

Atmospheric absorption of solar rays, using the term in the wide sense to cover every kind of depletion of the incoming rays, must be treated under two heads: (1) Band absorption, which takes place mainly in the upper air and at longer wave-lengths, which is quite local in its action, and must be expressed in terms of incipiency, rather than as a function of the density of the active absorbent; and (2) selective reflection, which acts chiefly in the lower atmosphere and at short wave-lengths, although it is not without some effect throughout the spectrum. The action in this case varies with the density of the absorbent medium, whether this be dust or air. A barometric formula expresses the air variation, but dust varies with the direction and strength of the wind, the height above sea level, the relative humidity, etc.[6] The usual formulæ for atmospheric absorption has been devised on lines suggested by the laws of luminous extinction through turbid media. They make no attempt to deal with the more troublesome line and band absorption, and the latter, at present, can best be treated graphically.

I can not insist too strongly on the necessity of the spectrobolometric method for obtaining a correct value of the solar constant; but when thus found, the knowledge may be used in interpreting the results of actinometric series, which, taken alone, lead to no definite result.

From Angström's work, Intensité de la radiation solaire à différentes altitudes, recherches faites à Ténériffe, 1895 et 1896, Upsala, 1900, I take the following summary of measurements of solar radiation, made with the compensating pyrheliometer of his invention:

Sun's zenith distance	The Peak: Barometer 492 mm, altitude 3,683 m.		Alta Vista: Barometer 518 mm, altitude 3,252 m.		Cañada: Barometer 597 mm, altitude 2,125 m.		Guimar: Barometer 734 mm., altitude 360 m.	
	ε	I	ε	I	ε	I	ε	I
°	*Atm.*	*Cal.*	*Atm*	*Cal.*	*Atm.*	*Cal.*	*Atm.*	*Cal.*
85	6.61	0.925	6.96	0.916	....	....	....	....
80	3.60	1.184	3.79	1.156	4.38	1.055	5.38	0.786
75	2.46	1.299	2.59	1.287	2.99	1.208	3.68	0.957
70	1.88	1.388	1.98	1.370	2.28	1.288	2.80	1.049
60	1.291	1.490	1.359	1.468	1.568	1.402	1.927	1.189
50	1.006	1.553	1.059	1.527	1.222	1.472	1.502	1.269
40	0.845	1.585	0.889	1.565	1.027	1.508	1.262	1.314
30	0.748	1.606	0.787	1.583	0.909	1.529	1.117	1.357
20	0.689	1.619	0.725	1.595	0.837	(1.530)	1.029	1.375
10	0.657	1.624	0.692	1.610	0.799	(1.540)	0.981	1.391
5	0.650	1.627	0.684	1.613	0.790	(1.542)	0.971	1.401

The curves showing the variation of intensity with air mass, intersect the axis of intensities near 2.0. If the solar constant be 3.1 calories, as has been strongly indicated by Langley's measures on Mount Whitney, as well as by those of Crova and Hanski in the Alps, its value at the time of these observations, near the summer solstice, must have been 0.1 smaller, or 3 small calories per square centimeter per minute. Of this, about one-third has disappeared, that is to say, about 1 calory is not accounted for by the increase of the

[5] Langley's bolometer makes the energy in this region about one-third of that in the whole spectrum, but as the instrument does not absorb the long waves completely, the ratio is certainly greater.

[6] We must guard against the supposition that the dust itself is necessarily dry. It may be only an exquisitely fine, watery mist.

air mass. Let us assume that this represents the loss by band absorption, and, as a first approximation, that this loss is the same for both stations. The difference of 0.15 to 0.25 calories between the highest and lowest stations for the same values of ε, must be largely due to dust, and since this concerns an initial radiation of 2 calories, a difference of 10 per cent must be made in the dust allowance at upper and lower stations.

Let A = the solar constant, B = band absorption, R = coefficient of transmission for scattering by air molecules, D = coefficient of transmission for scattering by dust (D_1 for mountain, D_2 for valley), I = intensity of observed radiation.

$$I = (A - B) \times R^{\varepsilon} \times D^{\varepsilon'}.$$

Assume $R = 0.95$, $D_1 = 0.85$, $D_2 = 0.75$, $A - B = 2$.

(1) For $\zeta = 5°$, mountain $\varepsilon = 0.65$, $\varepsilon' = 1.00$, $I = 1.627$;
(2) valley $\varepsilon = 0.97$, $\varepsilon' = 1.00$, $I = 1.401$.
(3) For $\zeta = 80°$, mountain $\varepsilon = 3.60$, $\varepsilon' = 1.92$, $I = 1.184$;
(4) valley $\varepsilon = 5.38$, $\varepsilon' = 2.56$, $I = 0.786$.

	I (computed).	Error.
(1)	$2 \times .95^{.65} \times .85 = 1.624.$	$-0.003.$
(2)	$2 \times .95^{.97} \times .75 = 1.427.$	$+0.026.$
(3)	$2 \times .95^{3.60} \times .85^{1.92} = 1.216.$	$+0.032.$
(4)	$2 \times .95^{5.38} \times .75^{2.56} = 0.727.$	$-0.059.$

The values of ε' have been computed on the same basis as in the example already given for Mount Whitney. That for the valley (2.56) is evidently too large, that is to say, there is not as much difference between the low-sun dust conditions at the top and bottom of the mountain as has been assumed in this computation, or as seems to have existed at Mount Whitney, where also the double ratio for k', combined with the 5 : 3 ratio for r in the computation of ε', was found to be a trifle too large. It is, of course, perfectly feasible to choose values which shall make the differences disappear, but I prefer to let the example stand as it is, for the instruction which it gives, my present purpose being to illustrate methods, and not to rectify results.

The quantity $A - B$ can not be a constant, but must vary with the moisture in the upper air, and, in general, must change with the seasons and the altitude. Thus, for the observations on Mount Whitney, which were made at a high altitude, and in a very dry atmosphere, $A - B$ is approximately 2.5. In the Tropics $A - B$ is probably nearer 1.5.

Let C = absorption of total solar radiation by carbon dioxid, assumed equal to 2 per cent and constant. W = absorption of total solar radiation by aqueous vapor, which is found to be dependent both on the absolute and the relative humidity, the absorbent power of a given quantity of moisture increasing as its state approaches that of saturation. Then

$$(a) \qquad W = -\frac{0.999 + \ldots}{1 + \log(1 + fh)^{y}},$$

$$(b) \qquad B = A.(1 - C)^{y}.\, W,$$

where, if f, the tension of aqueous vapor, is given in millimeters, and h is the fraction expressing relative humidity, the exponent y has the value 1.65.

Four cases may be taken, illustrating a wide range of terrestrial conditions from highest mountain, or coldest arctic climate, to the extreme moisture and heat of the Tropics.

(1)	$f = 1$	$h = \frac{1}{10}$	$fh = 0.1$
(2)	$f = 2$	$h = \frac{1}{4}$	$fh = 0.5$
(3)	$f = 20$	$h = \frac{1}{2}$	$fh = 10.0$
(4)	$f = 25$; $f = 33.3$; $f = 50$	$h = 1$; $h = \frac{3}{4}$; $h = \frac{1}{2}$	$fh = 25.0$

It is by no means certain that f and h enter as their product in the complex function with the variety of conditions under (4), ranging from those of a rainy season in the torrid zone, to that of a tropical desert, but I shall here assume this. The formulæ (a and b) give:

(1)	$W = 0.1159$	$B = 0.341$	$A - B = 2.659$
(2)	0.1680	0.494	2.506
(3)	0.4287	1.260	1.740
(4)	0.4984	1.465	1.535

The conditions on Mount Whitney fall between those of (1) and (2); those on Teneriffe between (2) and (3); while (3) appears to suit the average summer conditions at sea level in the temperate zone. It is this quantity ($A - B$), and not the solar constant (A), which is given by most of the published reductions of actinometric measurements.

If ever the law according to which the quantity ($A - B$) varies with the moisture can be established with greater precision, then the long series of actinometric measures from which at present nothing more than an estimate of this quantity can be deduced, will not have been made in vain.

The series of eighteen years duration, which is summarized by M. Eon in the Bulletin météorologique du département de l'Herault, 1900, p. 133, demonstrates the increase of the quantity ($A - B$) in winter and spring, verifying a fact, originally made known by M. Crova. The transmission by atmospheric aqueous vapor is greatest in the spring months. Langley and Abbot (Annals of the Astrophysical Observatory, etc., vol. 1, p. 207) find that at this season the aqueous bands in the spectrum become narrower and not quite so deep.

Crova's actinographs have demonstrated a diurnal variation of radiation connected with the convective distribution of moisture in the upper air, which depends upon the aqueous vapor supplied by surface evaporation. It is reasonable to expect that a more complete theory of the absorptive process will enable us to utilize observations made at all hours, deducing consistent values of the solar constant, whether the observations be made at morning, noon, or afternoon.

Greater attention should be paid to the theory of actinometers, and to the determination of their corrections, reducing all values to the absolute standard Langley's critique of Violle's actinometer (Researches on Solar Heat, chapters 5, 6, and 8), and Chwolson's investigation of the theory of Angström's differential pyrheliometer in Wild's Repertorium für Meteorologie (vol. 16, No. 5, 1893), as well as his critique of 166 pages on various actinometers (Wild's Repertorium für Meteorologie, vol. 15, No. 1, 1892), should be studied by all who wish to enter upon similar investigations.

Crova's absolute actinometer of 1898 (Comptes Rendus, vol. 126, p. 394), in which the receiving body is a disk of copper, 4 centimeters in diameter and 0.5 centimeter thick, blackened in front and polished on the other side, suspended by three fine threads in a water jacket, and having its excess of temperature above the blackened walls directly measured by an iron-constantan thermopile, appears to be a valuable instrument. It, as well as Violle's actinometer, however, should be used to measure initial rates of heating with both positive and negative values of θ.

Angström's differential pyrheliometer, as modified by Chwolson, employs a pair of receiving bodies very similar to Crova's disks, but without the advantage of the protecting water jacket, an advantage, however, which has not been fully utilized by Crova. Professor Callendar has shown (British Association for the Advancement of Science, Report for 1899, p. 36) that there is an appreciable time-lag in the heating of metallic disks considerably thinner than those of either Crova's or Angström's instruments. If used with equal positive and negative excesses in relation to the standard temperature of an enclosure, there is compensation, and the slowness of the conductive process is of less avail to vitiate the result.

Even where metal strips as thin as 1 or 2 microns are employed as a receiver, as in Angström's electric compensation

pyrheliometer, we can not be sure that the heat is fully recorded. I have found (Atmospheric Radiation, pp. 13–16) that such thin strips lose their heat mainly by convection, and that two minutes may elapse before complete convective and conductive equilibrium is established. In some of these instruments, the rear surface is left bright with the intention of confining the loss of heat chiefly to the front surface; and this would be thereby accomplished satisfactorily did not convection form so essential a part of the total loss. This, of course, goes on as well at the bright surface as at the dark. The heat produced by absorption of solar radiation at the blackened surface, escapes more easily than it enters, because the thin layer of black absorbent material transmits the long outgoing ether-waves much more freely than it does the shorter waves coming from the sun. Thus, it appears probable that the indications given by all of these so-called "absolute" actinometers are a little too small, and that we should not depend too much upon the agreement of measurements by different instruments and methods, since these may have equal constant errors. The only remedy for these defects lies in a most searching investigation of the complete theory of these instruments.

ICE CAVES AND FROZEN WELLS AS METEOROLOGICAL PHENOMENA.

By H. H. KIMBALL, Weather Bureau.

INTRODUCTION.

On page 71 of the MONTHLY WEATHER REVIEW for February, 1901, the Editor has stated that numerous natural ice caves are on record analogous to the interesting example near Flagstaff, Ariz. At his suggestion a special study of the literature bearing on the subject was undertaken by me, and I am now quite ready to agree with Mr. J. Ritchie, Jr.,[1] who says that "The best informed of scientists, even, are not aware of the mass of matter that has been written and published on this subject, owing to its distribution through the proceedings of so many learned societies." It was not until much time had been spent in searching through these proceedings, as well as through other departments of literature, that I became aware of a book entitled Glacières or Freezing Caverns, published in 1900, by Edwin Swift Balch, a member of the Philadelphia bar, and ex-president of the Geographical Club of that city, in which he mentions over one hundred and fifty authors whose writings were consulted by him in the preparation of his book. He also gives a list of some sixty-five places where subterranean ice forms in the United States, and nearly three hundred places for the whole world.

European ice caves.—So thoroughly has Mr. Balch covered this ground that it seems hardly necessary for me to review it. Mention will be made, however, of a work entitled Ice Caves of France and Switzerland, by Rev. G. F. Browne (London, 1865), and also of an article in Once a Week, Vol. II, p. 639, by Mr. Harold King, in which he gives an account of a visit to the famous Schafloch, an ice cave in Switzerland. From the descriptions of these two writers, in conjunction with those of Mr. Balch, it is evident that many of the ice caves of Europe are very grand affairs. Not only are the bottoms and sides ice coated, the latter often to unknown depths, but stalactites and stalagmites of great size and beauty are frequently to be found, giving the caves most fantastic appearances.

But the ice caves of the United States, if not so grand as those of Europe, are equally as interesting from a meteorological point of view. We therefore quote from several writers, in order that it may be seen under what a variety of conditions subterranean ice deposits are to be found.

[1] Paradoxical Phenomena in Ice Caves, Science Observer, April, 1879.

Ice cave in Washington.—In the Overland Monthly for 1869, Vol. III, p. 425, Mr. R. W. Raymond has given an account of a visit to a cave in Washington, in the Cascade Mountains, from which at that time ice was "packed" on the backs of mules and horses. He describes the cave as a channel in the basalt through which the melted lava continued to flow after the surface had become cooled and formed a crust. When, from any cause, the source of the melted lava has been cut off, these channels have been left empty, and it is in them that the ice is found.

Decorah, Iowa, ice cave.—In the Scientific American for March 29, 1879 (Vol. XL., p. 196), there is a description of a cave near Decorah, Iowa, by an anonymous writer, who thought that the ice formed in it only in summer and melted away every winter. But in the Scientific American Supplement for November 26, 1898, Mr. Alois F. Kovarik published the results of systematic observations of the temperature and the formation of ice in this cave, showing conclusively that the temperature fell steadily during the winter, that ice formed during the spring, and disappeared during the latter part of the summer.

These two caves, with the one near Flagstaff, Ariz., already mentioned, appear to be among the best examples of natural ice caves that are to be found in the United States, although there is a deposit of ice in the abandoned Cheever Mine at Port Henry, N. Y., that is fully as extensive. In all these cases the ice is deposited at a point in the cave considerably below the level of the entrance.

Ice beds in Connecticut.—In years past there have appeared descriptions of ice deposits that were to be found in deep ravines and gorges in the towns of Meriden[2], Northford,[2] and Salisbury,[3] Conn. In caverns or among the loosely piled boulders at the foot of the nearly precipitous sides of the ravines and under the shade of forest trees ice was said to form in winter in large quantities, and the rocks and trees protected it from the heat of summer so effectually that it was sometimes preserved until the early autumn. Of late years the existence of these ice deposits appears to have been nearly forgotten. In fact, recent letters to voluntary observers and others in or near these towns have generally elicited the statement that the ice formed only in a small way and was not preserved much longer than at other points in the forests among the mountains of that region. But our very energetic observer, Mr. L. M. Tarr, of New Haven, Conn., personally visited the ravine at Northford on June 19, 1901, with a party of friends, and reports as follows:

"Not far from the ravine the side of the mountain, which is composed of broken trap rock, is very steep. There are many trees on the top of the mountain and a few at its base, but during the most of the day this mass of rock is exposed to the direct rays of the sun. In these rocks, about 4 feet below the surface, much to my surprise we found ice. It was bedded in between the rocks, and could be taken out only in small pieces. There was considerable dirt mixed with it, as stated by Professor Silliman in 1822. I had my camera with me and took a snap shot of the place. (See Plate I, fig. 1.)

"The trees in the background of the print are on the edge of the ravine, which we examined throughout its entire length. At its bottom, near the base of the mountain, it is filled with small boulders, and under these are heaps of dead leaves and rubbish. I dug under some of the heaps of leaves, but found no ice. In ascending the ravine, we found two or three places where very cold water was trickling out of the rocks. I thought its temperature was not far from the freezing point, and concluded that it came, not from a spring, but from melting ice among the rocks. These were too heavy to move without a

[2] Silliman's American Journal of Science and Arts, 1822, vol. 4, pp. 174–177.

[3] Silliman's American Journal of Science and Arts, 1824, vol. 8, p. 254.

crowbar, which I did not have, and so could not investigate further.

"The ravine is very narrow, and, while well covered with trees, the shade is not so dense but that some sunshine penetrates it. I made an exposure with my camera, and inclose one of the prints. (See Plate I, fig. 2.) The picture was taken about half way up the ravine, but is a fair sample of its entire length.

"Although we did not find ice in the ravine, I have no doubt about its being there, and with a crowbar to move the rocks I think I should certainly have found it. I was surprised to find ice at Northford in such an exposed place, as the winter was not very cold in this vicinity, the snowfall very light, and the rains during April and May were unusually heavy."

Mr. Tarr writes that while the ravine at Meriden is much better known than the one at Northford, he has not been able to visit it personally; but from the accounts given him by others, it appears that little change has occurred there since Professor Silliman visited the place in 1822. This, says Mr. Tarr, is the testimony of Prof. A. W. Wright, of Yale, who visited the ravine in 1860; of Mr. Henry Hopkins, of New Haven, who found ice there on July 4, 1883; and of Prof. H. E. Gregory, of Yale, who found ice there during the summer of 1899, after the severe winter of 1898–99, but none during the summer of 1900, after the mild winter of 1899–1900.

Ice Mountain, Northriver Mills, W. Va.—Of a somewhat similar character is the celebrated Ice Mountain at Northriver Mills, Hampshire County, W. Va. Many descriptions[4] of this mountain have been given, and in all of them the ice is said to form in winter among the loosely piled boulders which compose the talus at its base. This ice slowly melts away during the summer, but at some little depth below the surface of the rocky heap it may be found throughout the year. Kercheval mentions a small log hut that had been built among the boulders by the owner of the property for the preservation of his milk, butter, and fresh meat, and states that when he visited the place, late in April, the openings between the logs in the side of this dairy next to the mountain, for eighteen inches or two feet from the floor, were completely filled with ice which also covered about one-half the floor to a depth of several inches. Mr. Duners, the owner of the property, informed him that milk, butter, or fresh meat of every kind were perfectly safe from injury for almost any length of time in the hottest weather.

Mr. George Deaver of Northriver Mills, W. Va., and Mr. R. H. Cookus, Voluntary Observer, United States Weather Bureau, Romney, W. Va., in letters of recent date, both testify that the ice still forms as in years past, and that the amount depends somewhat upon the snowfall of the previous winter, but that it can always be found at any season of the year by digging deep enough among the rocks. The old dairy building has, however, disappeared.

In the American Journal of Science and Arts, for 1844, vol. 46, page 331, S. Pearl Lathrop, M. D., has given a similar account of an ice mountain, or ice bed as it is called locally, in Wallingford, Rutland County, Vt.

Snow hole, Pownal, Vt.—In the American Journal of Science and Arts, 1818, Vol. I, p. 340, Prof. Chester Dewey of Williams College has given an account of a snow hole, apparently near the foot of West Mountain in the town of Pownal, Vt., about a mile from the southwest corner of the State. He says:

"The rocks are cleft in several places, and in one to such a depth that the snow and ice remain there through the year. The snow hole is about 30 feet long and nearly as deep at the east end, ascends to the west or toward the summit of the ridge, and is from 10 to 20 feet wide. When I visited it in June the snow was 6 feet deep on ice of unknown depth."

In Volume IV, p. 331, of the same journal, is an account of a visit to this snow hole in July, 1800, by Mr. H. A. S. Dearborn, and also of another visit by Mr. Thomas Ives of Yale College in July, 1818. Both found plenty of ice and snow. Mr. Ives adds:

"There is likewise a thick growth of evergreens and other wood about the entrance, which contribute to exclude the sun's rays. It is designated in the neighborhood by the name of the snow hole, the contents being rather snow than ice, a mixture of both."

In the same journal, Vol. V, p. 398, Professor Dewey mentions a visit to this place in August, 1822, when he found that the trees had been cut down to such an extent that very little snow or ice was to be found in the snow hole. He ventured the prediction that "The hand of man will probably destroy these natural depositories of snow, and in a few years they will doubtless be known only as the places in which snow used to be preserved through the year."

In Hitchcock's Geology of Vermont, Vol. I, p. 192, is a description of a frozen well, about a mile southwest of the village of Brandon, Vt. Similar wells have been noted at several places; among others, one at Owego, N. Y., which is described in Silliman's Journal of Science and Arts for 1839, vol. 36, page 184. In this latter the water froze so hard each winter, and remained frozen so late in the summer, that in 1855 it had been abandoned and the walls allowed to fall in.

ORIGINAL INVESTIGATIONS.

As reports indicated that the well at Brandon was still in good condition, and since the formation of ice in it, as well as in caves, seemed to be a meteorological phenomenon deserving of investigation the writer was recently instructed by the Chief of the Bureau to visit this well, and also the iron mines at Port Henry, N. Y., certain caves in the vicinity of Brandon, Vt., the so-called ice mountain at Wallingford, Vt., and a pit known as the "Refrigerator" at Cavendish, Vt., for the purpose of making a special study of subterranean ice deposits.

Mines at Port Henry, N. Y.—Leaving Washington on the evening of August 11, 1901, the first point visited was Port Henry, a charming town on the crest of one of the lower tiers of hills that rise in successive ranges, one above another, from the western shore of Lake Champlain. It is at the summit of one of the higher ranges, about 1,400 feet above the surface of the lake, that the Port Henry Iron Ore Company and the Witherbee, Sherman Iron Ore Company have sunk their shafts. There is nothing unusual about most of the mines. They are described as being warm throughout the year—too warm for health, in fact. But Mine No. 21, of the Port Henry Iron Ore Company is remarkable in that ice is found in it throughout the year, and in winter it is so cold as to cause suffering on the part of the miners. Few observations of temperature have ever been taken in this mine, but the superintendent, Mr. Pierce Clonan, informed me that one bitter cold day in January, 1897, when the miners were complaining more than usual, he hung a thermometer in one of the levels, and after an hour or so it read —38° F. The miners were never informed of this observation, for fear they would refuse to work.

The reason for this remarkable cold is not difficult to give. Some years ago mining experts decided to blow off the roof of this mine, and the heaviest charge of dynamite that had ever been fired in this country was used. As a result the entrance to the mine is now a deep pit several hundred feet in diameter at the top, but tapering to a shaft only a few feet in diameter at the bottom, 500 feet below. Previous to this explosion, when No. 21 was a closed mine, it was warm like the others. Since then it has been a cold mine. When the

[4] See Kercheval's History of Virginia, Winchester, 1833. Historical Collections of Virginia, H. Howe, Charleston, S. C., 1846. Maxwell and Swisher's History of Hampton County, Va., etc.

September frosts appear at the surface the cold frosty air of early morning settles through the wide mouthed pit into the levels below, and frost and icicles commence to form there. As the cold of winter comes on the cold in the mine keeps pace with it, but with this interesting modification; a bright sunny day in midwinter, with a crisp northwest wind, is often a bitter cold day in the mine. This is perhaps due to the fact that during our coldest winter mornings, which are often followed by bright sunny days, the cold, dense air gravitates to these low levels, while the warmer air of midday has no tendency in that direction.

Mr. Clonan informed me that in general a northwest wind was accompanied by cold weather in the mine and a south wind by warm weather. But this is also true at the surface. However, since the general direction of the levels is south from the shaft, a northerly wind would blow, directly into them and a southerly wind away from them, and this might have some effect upon the temperature in the mine.

It was on the morning of August 13, 1901, that in company with the Assistant Superintendent, Mr. Edward Clonan, a visit was made by me to this mine. We descended in one of the ore buckets that run on a track that is inclined at an angle of about 60° from the horizontal, and that rests on the north side of the pit already described. It was a beautiful, bright morning, and just before starting the temperature in the shade of a building was 66.0°, and the relative humidity 71 per cent. Almost immediately after we commenced to descend the fall in temperature was noticeable. The deep pit was full of cool air. Considerable water was trickling down the south side of the pit, and near the bottom it was running over a sheet of ice. Just below the ice sheet was the opening to an old level, with icicles hanging from the roof, while on the floor of the level was an ice stalagmite, locally known as the "iceberg," that was not less than 6 feet high and 30 feet in diameter at its base. One side of it had been melted away by the water dropping from above. The temperature of the air just above this ice, 470 feet below the surface, was 36.4° F. In a little pool on the surface of the ice the temperature of the water was 32.0°.

Numerous observations were taken in the various levels with a Weather Bureau sling psychrometer, and the following table is a summary of the results:

Observations at Port Henry Iron Ore Company, Mine No. 21, *August* 13, 1901.

Time.	Place of observation.	Psychrometer. Dry.	Psychrometer. Wet.	Relative humidity.
		°	°	*Per cent.*
8:15 a. m.	Outside, near mouth of pit	66.0	60.0	71
8:45 a. m.	500 feet below the surface	37.2	37.0	98
	536 feet below the surface	37.2	37.0	98
	536 feet below the surface	36.8		
	536 feet below the surface	36.2		
	536 feet below the surface	37.1		
	550 feet below the surface	38.6		
	550 feet below the surface	39.0		
	470 feet below the surface	36.4		
9:50 a. m.	500 feet below the surface	37.8		
10:20 a. m.	Outside, near mouth of pit	71.0	62.5	62

The lowest air temperature, 36.2°, was taken at what is known as the center of the mine, nearly under the iceberg; the next lowest temperature, 36.4°, on the surface of the iceberg; and the highest temperature, 39.0°, at the lowest level, in a "heading" where ore was being taken out. In general the temperature was higher in the newly extended portions of the levels than in the older portions. The superintendent attributed this to the fact that there was not so much moisture here and consequently less evaporation, but I am inclined to attribute it to the fact that the newly uncovered rock surface is not so cold as surfaces that have been long exposed to the air. In the severest winter weather the fresh dug ore is not frozen.

This mine is considered a very dry mine but in summer there is water running in most of the levels, coming in principally from the surface. It commences to freeze in September and remains frozen until the following May. A winter thaw is dreaded because it sends large quantities of water into the mine over the ice, and unless it is promptly drained into the "basin" and pumped out of the mine the accumulation of ice becomes serious. In fact, the only considerable accumulation of ice is at the iceberg on the old 470-foot level, the face of which is filled quite full each winter. If left to itself no doubt great quantities of ice would accumulate in the lower levels of the mine, as has been the case in the abandoned Cheever Mine, at Port Henry, which I am credibly informed has nearly filled with ice, and a few years since, when the supply in the local ice houses failed, ice was taken from this mine and sold to the citizens of the town.

I took an air meter into Mine No. 21, and near the bottom of the pit by which we entered a slight movement of the air out of the mine was apparent. Farther in, and on the lower levels, not a particle of movement could be detected, and the fog from our breath rose slowly and very nearly vertically. The currents are said to be strong in winter, particularly with a northwest wind. The air was filled with a bluish smoke, closely resembling fog. It is said that in damp weather the fog in the mine is dense.

Miller Pit is an abandoned mine close by No. 21; and standing on the surface, beside the rather open entrance, ice could be seen not more than 100 feet below, where the water flowing in from the surface was frozen during the past winter. It was here that a boy lost his life on July 4 last; while attempting to obtain some of the ice he slipped upon it and fell down the shaft to the bottom of the mine.

The Pittsford, Vt., ice cave.—The next day, August 14, in company with Mr. C. E. Farrington of Brandon, Vt., a visit was made to the Pittsford ice cave, about 9 miles southeast of Brandon. Although the existence of this cave has been known to the people in its vicinity for at least a century, very little has ever been written about it. It was brought to my attention by a press report of a descent into it by Professor Adrian Ronalds of Rio de Janeiro, and his daughter. The report stated that the descent was very dangerous; that the temperature of the cave was far below freezing; that an icy blast of great strength was blowing out of it; and that Professor Ronalds dug out of the ice a frog that had been imprisoned there not less than 2,000 years. Evidently this report needed to be accepted with due allowance for exaggeration.

The cave is located on the side of a mountain spur known as Ball Peak. Leaving our carriage at the foot of this peak, a climb of about one-third of a mile brought us to the entrance of the Pittsford Ice Gorge, which lies between Ball Peak and East Peak. This gorge resembles somewhat the ravine at Northford, Conn., shown on Plate I, fig. 2, except that its sides are steeper, the boulders covering its bottom larger, and the trees smaller. Just before entering it, at 12:25 p. m., an observation with the psychrometer under the shade of a tree gave a temperature of 76°, but no sooner were we inside than we were aware of a marked fall in temperature. Between the boulders in the bottom of the gorge were many small pits or caverns, and in some of these it was possible to measure the temperature at a depth of 5 or 6 feet below the surface. In one, not more than three rods from the entrance to the gorge, the temperature was 50°; in a second, a little farther in, it was 46.8°, and in a third, still farther in, 45.8°. Moisture was deposited upon the boulders forming the sides of the caverns, and also on the few ferns they contained.

Our guide informed us that in winter snow fills the gorge to a great depth. When it melts away in the spring ice must

form in the spaces among the boulders to a considerable depth below the surface, and some of it may be preserved throughout the summer. But there was none in sight and we could not penetrate the loosely piled rocky mass except in the small caverns here and there, as above stated.

The gorge rises as we advance, and near the summit, where the rise is unusually steep, there is a small hole in the side of Ball Peak that might easily be passed unnoticed. We enter and find ourselves in a small vestibule, in the floor of which is an opening some 6 feet in diameter. Against one side of this rests a substantial ladder. We light our lanterns and descend to the first landing, not over 20 feet below. A steeply inclined pathway into the mountain takes us about 30 feet below the entrance, and to the edge of a dark and apparently bottomless pit. But there is a small opening on one side of the passageway, and into this we slide, feet foremost. A winding tunnel presently brings us into the pit we had seen from above.

Almost immediately we step upon a mass of broken ice that covers the rocky decline leading to the center of the pit. This ice undoubtedly marks the bed of the stream by which surface water enters the cave from the gorge in the springtime. There is a similar frozen stream at the other end of the pit. At the bottom is a sheet of ice about 12 feet wide and 20 feet long. We can only guess at its depth, but the fact that here and there the point of a rock protrudes through it indicates that it is not deep. This inference is confirmed by the statement of our guide that he has seen the bottom of the pit perfectly dry later in the season. He also states that early in the spring the ice is sometimes 20 feet thicker than at the time of our visit, but the little frozen rivulets above mentioned indicate that in the spring of 1901 it was not more than 4 or 5 feet thicker than now, in August.

The appearance of this pit in the feeble light of our two lanterns was imposing. The sides are of solid rock, without seams. Separated from each other at their bases by a space of about 12 feet, one side stands nearly vertical, while the other leans over and rests against it about 30 feet above our heads. There is a passageway leading from the pit farther into the mountain which we did not explore.

Observations with the psychrometer while standing on the ice gave an air temperature of 35.2° and a relative humidity of 98 per cent. The air was very clear, in marked contrast to the air in the Port Henry Mine. While the sides of the pit were covered with moisture, probably from condensation, no water was flowing into it, and there was none on the surface of the ice. In a narrow space between the ice and the side of the pit the water had a temperature of 32.2°.

As we clambered out of the cave we saw daylight through a passageway leading from the landing at the foot af the ladder. It is possible to enter the cave through this passageway, therefore, in fact, the bottom of the pit is only about 40 feet below an opening communicating with the outer air. The temperature at this landing was 57.5°.

It seems perfectly clear that the air in this cave, as well as its rocky sides, are cooled to a very low temperature in winter. During the "spring thaw" water flows in from the surface, and is frozen. During the summer the temperature rises very slowly, since heat both from the interior of the earth and from the surface is conveyed but slowly by the rocks, and there is no tendency for the warm surface air to flow in and replace the cold, dense air of the cave. Our air meter failed to detect the slightest movement of the air either in the passageway leading to the pit, or in the pit itself.

Leaving the cave we climbed up the side of the gorge, and passing directly over the top of Ball Peak (elevation about 1,700 feet) we returned to our carriage at the foot of the mountain. The temperature on the summit at 1:45 p. m., was 78.4°, and at 1:55 p. m., a short distance below the entrance to the gorge it was 79.0°.

Bat Cave, Chittenden, Vt.—A drive of six miles northward along the side of the mountain brought us to the foot of Mount Chaffee, in Chittenden. We climbed up the side of this mountain about a half mile, to Bat Cave, which was reported to have very low temperatures in some of its compartments. The entrance to this cave is under an imposing stone arch that is tilted at a considerable angle with the horizontal. We descended a short distance by an inclined pathway, and then found ourselves on the edge of a precipice, with a dark pit of unknown depth below, as was the case in the Pittsford ice cave. And here also we found an opening into a tortuous tunnel, through which we slid, feet foremost, into a commodious apartment about 20 feet below the entrance. At 4:55 p. m., just before entering, the air temperature outside was 72.0°; here it was 47.4°.

There is a small hole leading out of the farther side of the compartment, so small that our lantern had to be extinguished, pushed ahead endwise, and relighted. Then, while lying flat on our stomachs with our hands straight out in front, by digging our toes into the soft dirt that constitutes the bottom of the cave, we were able to push ourselves ahead inch by inch. We confess to a creepy sensation when we were well into the hole, which we fitted like a finger in a glove, so that our hands and arms were quite useless.

This passage passed we found ourselves in a compartment of sufficient size to permit of swinging our psychrometer without difficulty. Here the temperature was 47.2°.

A passageway no larger than the one by which we had entered, and anything but straight, led out of the farther side of this second compartment. We did not consider it prudent to extinguish our light and try to advance in the dark by such a path, so we abandoned further exploration and crawled out of the cave as we had crawled in.

I do not think ice could be preserved in this cave for any length of time. The open mouth of the first compartment readily admits of the circulation of air through it. The other compartments are on the same level with the first, and hence must have about the same temperature. Consequently, while this cave should become very cool each winter it is readily warmed each summer.

Silver Mine, Brandon, Vt.—There is an abandoned silver mine near Bat Cave that, the owner informed me, often contains ice throughout the year. Some years since, when about to resume operations, a great quantity of ice had to be removed by forcing steam upon it through a pipe.

There is an interesting legend connected with this mine. As told by the present owner, the mine was worked by the Spaniards before the country was settled by the English. When they abandoned it they left behind large quantities of silver, some in bars and some in Spanish dollars. The presence of all this treasure was made known by one of the Spaniards, the last survivor of the band of miners, who returned when an old man and searched in vain for it until his death. The search has been continued at intervals by different parties until now, the present owner having spent the best part of his life in this work. He is thoroughly convinced of the existence of the treasure. A legend similar to this, except that the treasure is located at Wallingford, Vt., is related on page 841, Vol. II, Hitchcock's Geology of Vermont.

Ice bed, White Rock Mountain, Wallingford, Vt.—Reference has already been made to the ice bed at the foot of White Rock Mountain in Wallingford. On the afternoon of August 15, in company with Messrs. C. S. Saunders and C. N. Batcheller, a visit was made to this mountain, the general appearance of which is well shown in Plate II, fig. 1. Near the foot of the mountain, on the southwest side, is an immense talus of quartz rock, the characteristics of which will be understood

from Plate II, fig. 2., which is from a photograph by Mr. Batcheller. I crept in among the boulders near the foot of the mountain a distance of 10 or 12 feet, and found the temperature to be only 45.1°. At another point, a little higher up, the temperature was 46.7°, and at a third point, very near the first, it was 45.0°. The surface air temperature halfway up the talus was 70.0°, and a spring of water flowing out from under the base had a temperature of 41.1°. By the side of the spring air temperatures of 56.2°, 65.0°, 57.7°, and 64.0° were obtained within the space of a few minutes, showing the influence of cold air currents that were flowing out from among the boulders. While no ice was to be seen, Mr. Saunders assured me that it could usually be found there throughout the year, and that it had been found not more than two weeks previous to my visit. The very low temperature of the spring water, as well as of the air flowing out from among the boulders, indicates the presence of ice in considerable quantities at inaccessible depths in the talus.

Wherever we went among the mountains we found the most beautiful springs of pure, clear, and sparkling water; but this one at the foot of White Rock Mountain was by far the coldest. The most copious was at the foot of Mount Chaffee, in Chittenden, and it had a temperature of 45.8°. A smaller one, a short distance below the entrance to the Pittsford Ice Gorge, had a temperature of 52.0°.

The Refrigerator, Cavendish, Vt.—Near the foot of the gorge on the Black River at Cavendish, Vt., is a sort of open pit, which is sheltered from the direct rays of the sun by forest trees. In this pit the snow and ice naturally accumulate in winter, and do not disappear until late in the spring. For this reason it has received the name "Refrigerator," which it scarcely deserves, since its temperature on the day of our visit, August 16, was 66.4°, while a short distance above it, on the bank of the gorge, the temperature was 75.2°.

Frozen Well, Brandon, Vt.—In the mines at Port Henry, in the Pittsford ice cave, and in the talus at the foot of White Rock Mountain conditions are such that considerable quantities of ice can be stored up each winter where it will be protected from direct radiation, and also from air currents in summer. In fact, these places have very appropriately been called natural ice houses. In the frozen well at Brandon we now have to consider a phenomenon that has been thought by some writers to be of a somewhat different character.

A great deal has been written about this frozen well. Hitchcock, in his Geology of Vermont, devotes several pages to it, and Balch refers to it several times in his Glacières and Freezing Caverns. Formerly it was considered one of the curiosities of the town, and it was customary to conduct visitors to it. Of late years it has become an old story with the residents, and comparatively few people visit it. Indeed, it is quite commonly reported that the well has lost its virtue and no longer freezes as formerly. This is not the case. The well still freezes each winter, and this year remained frozen solid until after June 1. On August 13, the date of my visit, the temperature of the water was 42°. A lantern was lowered to the bottom and no ice was to be seen. Light streamers of paper were attached to the sides of the lantern, and they failed to detect any movement of air through the well.

We talked with the owner, Mr. C. V. Luce, who stated that when the well was dug in November, 1858, a layer of frozen gravel was struck at a depth of fourteen feet, underlying a layer of clay. The frozen stratum had a depth of from twelve to fifteen feet, and below it was a second layer of clay, under which water was found in a gravel formation. For some years after the well was dug the ice accumulated in it in such quantities that it had to be abandoned during the winter months, and it always froze solid. It was then the custom to cut a hole through the ice to the gravel below on Memorial Day (May 30). No water would appear at first, but after a few hours the hole would be filled with it, and ice would form on its surface. A blow from the bucket was sufficient to break through this ice, however. Later a tight cover was made for the well, and the ice that formed at night, even in mid-winter, could be broken in the morning by dropping upon it a heavy sledge hammer attached to a rope.

It is worthy of note that while the water in this well has never failed, the supply is so small that the well can easily be dipped dry at any time.

Various theories have been advanced to account for the presence of the frozen stratum encountered when the well was dug. Hitchcock thought it of glacial origin,[5] and that it had been preserved through the intervening thousands of years, because it was so thoroughly insulated from heat, coming either from the surface or from the interior of the earth, that the cold due to evaporation from the earth around it was sufficient to maintain its temperature below the freezing point. Hager,[6] on the other hand, could not accept this explanation. He thought it more probable that the ice encountered had accumulated and been preserved in much the same manner as in the ice caves and in the mines at Port Henry.

The peculiar character of the geological formation in the vicinity of the well favors the penetration of the cold in winter to unusual depths. Plate III, fig. 1, shows the south end of a moraine that extends northeasterly for some distance from the valley of Otter Creek, passing close by the well. The valley of Otter Creek is seen in the background. Plate III, fig. 2, is a view of the interior of this moraine, taken in a pit near the well. At this point the moraine consists of pebbles, mostly of small size, perfectly free from sand or dirt. Water would flow freely through such a formation, and, under favorable circumstances, air should circulate through it. Plate III, fig. 3, shows the formation on the southeast side of the moraine somewhat nearer the well, where the pebbles are slightly coarser, and are cemented into a conglomeritic mass, which may be broken in pieces by the hand.

Otter Creek Valley is supposed at one time to have been a lake, and this moraine was a shore of an arm of the lake. Deposit on the bottom of the lake formed what is now the soil of the meadows, and it naturally overlies the lower edge of the moraine. In digging the well the first fourteen feet was through deposit from the Lake. Then the pebbles of the moraine were reached, and it was in the interstices between these pebbles that the ice was found.

It seems rational to explain the formation of the ice in this stratum by the same general principles that apply to the other cases we have studied, if we can do so; that is to say, by a circulation of cold air during the winter between the pebbles composing the moraine, thereby lowering the temperature of the pebbles themselves, so that any water that may find its way in during the spring thaw will be frozen. We know that the natural tendency of the cold, dense surface air in winter must be downward to replace the warmer and lighter air beneath the surface. The passage of successive areas of high and low pressure will intensify this tendency, by alternately compressing and expanding the air beneath the surface. It is conceivable that each area of high barometer should force cold air beneath the surface, while each area of low barometer should allow warm air to flow out. It is also conceivable that the arrangement of the strata of the earth's crust might be such that the cold air would flow in at one point and the warm air out at another. A siphon movement might even be established, by means of which a cold current would continually enter the ground at one point and a warm current continually flow out at another.

There is evidence of just such a circulation through the

[5] Geology of Vermont, Vol. I, page 201.
[6] Hitchcock's Geology of Vermont, Vol. I, page 205.

strata composing this moraine. At a point on the side of the moraine not far from the well, and south of the gravel pit shown in Plate III, fig. 2, it was noticed in years past that the snow always melted in winter, so that the ground would be left bare, while all around it was covered with snow. This looks very much as though warm air was coming out of the ground at this point. The phenomenon has not been observed of late years, but this is not strange, since the configuration of the moraine has been much changed by excavations, and, as already stated, but little attention has been paid to the well. Such currents would naturally cease in summer.

We may therefore safely assert that the conditions here are unusually favorable for the circulation in winter of cold air through the stratum in which the ice was found. Furthermore, as has been pointed out by Hager and Hitchcock, the layers of clay both above and below the ice help to insulate it from heat in summer both from the surface and from the interior of the earth. We are therefore in accord with Hager[7] and Balch[8] in concluding that this well, like the ice caves, is a *natural refrigerator*.

Mines in McClellan Mountain, Colo.—An ice formation somewhat similar to that at the Brandon, Vt., frozen well is found at Georgetown, Colo., in the Clear Creek County Mines in McClellan Mountain. Mr. E. L. Berthoud[9] thus describes it:

"The discovery-drift of the Centennial Lode runs into McClellan Mountain at an altitude above 13,100 feet on a course southwest, at about 30 feet from the entrance of the tunnel. Intercalated in the vein I found three or four well defined veins of solid ice, parallel with the bedding of the rock, and filling all its thinner side cracks and fissures; in fact, after further examination, I found that the frozen stratum, and the congealed, hard earth, rock, and gravel began only a few feet below the accumulated rock and débris of the mountain slope, and continued as far as the excavation reached, some 40 feet in depth.

"From the Centennial Lode I went westward about 300 feet and examined the drift that has been excavated into the mountain some 500 feet upon the vein of the International Lode. Here there is repeated the same frozen substratum and the same rift or veins of ice in the country rock and in the vein. I went into the tunnel about 100 feet and found that this glacial condition still existed; the owner of the mine assured me that the ice and frozen rock continued all the way to the end of the tunnel and caused a good deal of extra expense in mining the ore.

* * * * * * * *

"This is certainly a singular phenomenon when we consider that across the narrow valley north of McClellan Mountain, not over three-fourths of a mile distant, and upon another high peak, the limit of tree growth exceeds 12,400 feet elevation on the south slope of that peak.

* * * * * * * *

"It has been suggested[10] that the frozen soil and rock of some mines examined by him, northwest from McClellan Mountain, on the west slope, have been thus left icebound since the Glacial Period, and that they thus retain their former icebound condition, from the excessive altitude of the mines there explored.

"This may be the case, but it seems doubtful.

* * * * * * * *

"I am inclined to the belief that the glacial condition of McClellan Mountain is due to local causes. Prominent among these would be the loose nature of the soil and deep rocky débris of the mountain, and the slow percolation of water exposed to excessive evaporation that is promoted and quickened by continued gales from the north and northwest that strike against the precipitous face of the mountain range in that direction. The opposite slope, on the contrary, which shows the abnormally high timber line, faces a pass 13,100 feet high which gives a way perfectly unobstructed for south-southwest winds."

It is evident that ice caves and frozen wells are but different manifestations of the same phenomenon. In both cases the cold air of winter circulates to unusual depths below the surface, and freezes the small quantity of water with which it comes in contact. In summer this subterranean circulation of the air ceases, and heat finds its way to the ice only by the slow process of conduction. In consequence, the ice that accumulates during the winter and early spring may not entirely disappear during the following summer, but continue to accumulate for ages.

[7] Hitchcock's Geology of Vermont, Vol. I, p. 207.
[8] Glacières or Freezing Caverns, p. 79.
[9] Silliman's Am. Jour. Sci., 1876, vol. 111, p. 108.
[10] R. Weiser, Am. Jour. Sci., 1874, vol. 108, p. 477.

OUR KILLING HEAT.

By Gen. HENRY L. ABBOT, dated Cambridge, Mass., Aug. 21, 1901.
[Extract from Boston Transcript.]

In view of the general interest in tropical climates induced by recent events, perhaps you would like to receive figures extending the comparison to the Isthmus of Panama. I have just received the July sheets of two self-registering thermometers, which, for several years, have been in use by the New Panama Canal Company in its study of the elements which have a bearing upon the completion of its works now in progress on the isthmus. One station, Alhajuela, is situated about a dozen miles from the Atlantic coast, on the Upper Chagres River, where the reservoir dam will be placed; the other, La Boca, lies on the Bay of Panama, and forms the new terminal of the Panama Railroad. Both are nearly in latitude 9° north. The figures, therefore, present both the interior and the coastwise climates of the isthmus. The mean monthly temperature (including every hour of July) was at Alhajuela 77.4°, at La Boca 81.5° F. The table below exhibits the extraordinary uniformity of the climate, the mercury only once rising above 90°, and never falling below 80° at the hottest hour of the day. It may be added that this monthly record might represent any other month of the year, there being no sensible difference in winter and summer, although the range in the twenty-four hours is distinctly greater in the four dry months than in the eight rainy months.

Isthmian daily maximum temperature in July, 1901.

Date.	Alhajuela.	La Boca.	Date.	Alhajuela.	La Boca.
	°F.	°F.		°F.	°F.
1	82.4	82.4	17	83.8	84.4
2	82.2	83.8	18	83.8	84.2
3	88.3	86.5	19	80.1	80.8
4	87.6	87.8	20	86.0	84.6
5	83.3	85.3	21	85.8	88.0
6	86.2	87.4	22	85.8	84.9
7	82.8	84.2	23	82.4	84.7
8	85.6	87.8	24	91.2	86.2
9	82.8	82.2	25	87.8	86.0
10	83.3	85.1	26	86.4	84.4
11	86.2	87.4	27	82.1	83.1
12	86.0	86.5	28	86.0	86.9
13	84.2	88.3	29	81.0	84.2
14	84.2	85.1	30	87.4	87.8
15	81.9	84.0	31	87.8	88.5
16	88.9	88.2			

These figures demonstrate, what is well understood, that it is the uniformity of the heat and not the highest temperature that is characteristic of the Tropics and that renders the climate oppressive.

THE MOON AND THE WEATHER.

By LEVI W. MEECH.

For many years past the accepted doctrine has been that the moon has no influence upon the weather. On examining the method of Lubbock to establish this conclusion,[1] it appeared that certain terms had been averaged out by defective analysis. For a preliminary trial of a more correct method the observations of temperature given in Dr. Kane's Arctic Explorations, Volume II, pp. 405–425, from September, 1853, to April, 1855, were examined. Adopting as the mean temperature of 1854, —5.01° F. and a range of 76.49° for the station whose location was latitude 78° 37′ N. and longitude 70° 40′ W., I deduced the following formula, representing the temperature in Fahrenheit at any moment for which the sun's right ascension is s and the moon's right ascension m:

$$
\begin{aligned}
t = &-2.81^\circ + 35.47^\circ \sin(s - 27^\circ 3') \\
&- 7.20^\circ \sin(2s + 68^\circ 52') - 4.22^\circ \cos(m - 53^\circ 0') \\
&+ 2.82^\circ \cos(2m - 65^\circ 43') + 2.73^\circ \cos(m - s + 38^\circ 43') \\
&+ 0.84^\circ (\sin 2m - 2s - 68^\circ 0') +, \text{etc.}
\end{aligned}
$$

This beginning of a discussion by the astronomic method was made many years ago and after being long mislaid has recently been recovered. The original design was to extend the formulæ of Euler, Poisson, etc., into others in which the substitution of the elements of the current weather would enable us to predict such elements for several days in advance. Possibly, the cycle of nineteen years, or thirty-five years, may be required for data at first—an inviting field of research.

TORNADO AND WATERSPOUT AT NORFOLK, VA., ON AUGUST 6, 1901.

By JAMES J. GRAY, Local Forecast Official.

The following is a report on the waterspout and tornado which occurred at Norfolk, Va., about one mile east of the Weather Bureau office, between 1:10 and 1:20 p. m. of August 6, 1901. The data were collected from Captain Miles of the tug *Mars*, and Capt. H. H. Williamson, No. 302 Marshall avenue, this city.

Captain Miles states that his tug was tied up in the slip near the Norfolk and Western grain elevator. At 1:10 p. m. he observed an eddy, or small whirlwind, form about the corner of the elevator, taking up a cloud of dust and trash from the dock below within its whirl. The whirl grew more violent, and extended to the mass of cumulo-nimbus clouds above; moved east-northeast, up the river, about 700 feet, whipping the water into foam and raising it in its vortex to the height of 15 or 20 feet. At this time the spout seemed to have a diameter of about 8 to 10 feet, and a well defined funnel extended from the cloud to the water. It now changed its course toward north-northwest, and striking the land it rose from the earth, the bottom of the funnel just clearing the housetops. About 600 feet farther on it lowered and struck a pine tree 16 inches in diameter and broke it off 5 feet above the ground; the tree fell in a northeasterly direction. The tornado then moved north-northeast for about 400 feet, tearing up grass and weeds. Reaching Charles street a row of 6 brick houses was unroofed, the roofs thrown to the northeast and the bricks from the top of the walls scattered in a northwesterly direction. This seemed to cause the tornado to rise slightly, but after moving northward for about 300 feet it descended at the corner of Charles and Allen streets, striking an apple tree 17 inches in diameter, which fell in a southeasterly direction. The tornado here changed its course to north-northeast and moved 700 feet, where it unroofed 7 houses on Shelton avenue, throwing all the roofs to the east. It then moved north 800 feet, striking a dwelling and a blacksmith shop, unroofing both; then it rose, moving northward, gradually losing its force and the funnel dissipated.

The tornado was accompanied by the usual roaring, but by no lightning at all. There was no rain during its progress but a downpour of about two minutes duration occurred about five minutes later. A girl was struck by a piece of flying timber and slightly injured.

The diameter of the tornado did not apparently exceed 15 feet at any time. I went over its track and noted carefully the position of the fallen trees and broken timbers. The unroofed houses were not otherwise injured and there were no signs of internal atmospheric expansion, as not a single window in any of the buildings was disturbed at all, so far as I could see. The part of the town over which the tornado moved is thinly settled.

At this office, for an hour or so before 1 p. m., the wind was light southeast, and at 1:10 p. m. it shifted to northwest with a slight squall of 18 miles per hour for a few minutes, when it went back to light northeasterly. The barometer was about normal, falling 0.05 inch from noon to 2 p. m., with unsettled weather and squally conditions.

NOTES BY THE EDITOR.

ORGANIZATION OF THE PHILIPPINE WEATHER BUREAU BY THE UNITED STATES PHILIPPINE COMMISSION.

AN ACT PROVIDING FOR THE ESTABLISHMENT OF A WEATHER BUREAU FOR THE PHILIPPINE ISLANDS, AND APPROPRIATING EIGHT THOUSAND AND SIXTY-SIX DOLLARS AND FIFTY CENTS ($8,066.50), IN MONEY OF THE UNITED STATES, FOR THE PURCHASE OF METEOROLOGICAL INSTRUMENTS AND APPARATUS AND THE INSTALLATION OF THE SAME.

By authority of the President of the United States, be it enacted by the United States Philippine Commission, that:

SECTION 1. A weather bureau is hereby established for the Philippine Islands. It shall be known as the Philippine Weather Bureau.

SEC. 2. The officers of this bureau shall be: A Director, at an annual salary of two thousand, five hundred dollars ($2,500); three Assistant Directors, at an annual salary of one thousand, eight hundred dollars ($1,800) each; and one Corresponding Secretary and Librarian, at an annual salary of one thousand, four hundred dollars ($1,400). They shall be appointed by the Commission.

SEC. 3. The employees of the Weather Bureau shall be:

(*a*) For the central station, three first-class observers, at an annual salary of nine hundred dollars ($900) each; three calculators, at an annual salary of seven hundred and twenty dollars ($720) each; two assistant observers and an assistant librarian, at an annual salary of six hundred dollars ($600) each; two assistant calculators, at an annual salary of three hundred dollars ($300) each; one first-class draughtsman, at an annual salary of seven hundred and twenty dollars ($720); one second-class draughtsman, at an annual salary of six hundred dollars ($600); one first-class mechanic, at an annual salary of seven hundred and twenty dollars ($720); three assistant mechanics, at annual salaries of six hundred dollars ($600), four hundred and twenty dollars ($420), and

[1] Companion to the British Almanac, 1839, and London Phil. Trans., 1841.

three hundred dollars ($300), respectively; two janitors, at an annual salary of one hundred and fifty dollars ($150) each; and two messengers, at an annual salary of one hundred and fifty dollars ($150) each.

(*b*) For the branch stations: Nine (9) chief observers for first-class stations, at an annual salary of six hundred dollars ($600) each; nine (9) assistant observers for first-class stations, at an annual salary of one hundred dollars ($100) each; twenty-five (25) observers for second-class stations, at an annual salary of three hundred dollars ($300) each; seventeen (17) observers for third-class stations, at an annual salary of one hundred and eighty dollars ($180) each; twenty (20) observers for rain stations, at an annual salary of ninety dollars ($90) each.

(*c*) All employees of the Weather Bureau shall be appointed by the Director, subject to the provisions of the Civil Service Act and of Act 25.

Sec. 4. The Director shall have supervision and control over the work of the Bureau, and shall define the duties of the Assistant Directors, of the Corresponding Secretary and Librarian and of all employees. He shall maintain an efficient system of weather forecasts and storm warnings, and shall each day forward forecasts and storm warnings, if any, to the captains of all ports in the Archipelago which are in telegraphic communication with the capital, to the chief executive of the Insular Government, to the Commission, to the heads of all civil departments and bureaus in Manila, to the commandant of the naval station at Cavite, and to the public press of Manila, Cebu and Iloilo. When dangerous storms threaten any portion of the Archipelago, he shall send telegraphic warnings to the threatened district, if practicable. Forecasts and storm warnings shall be sent to all branch stations in telegraphic communication with the central station, and there posted for the benefit of the public. Warnings of dangerous storms likely to strike the Asiatic coast, Formosa or Japan, shall, if practicable, be communicated by telegraph to the directors of meteorological observatories situated within the threatened areas, or to such persons as may be officially designated by other governments to receive them. The Director shall further cause to be prepared a monthly bulletin and a monthly report. The monthly bulletin shall contain a brief résumé of the chief meteorological phenomena of the preceding month, and a comparison between the phenomena observed and the normal conditions for the month in question, as a résumé of the crop reports received from the branch stations. Five hundred copies of this bulletin in English and five hundred in Spanish shall be published by the Director for free public distribution. The monthly report shall contain the observations made at the Central Station and the branch stations, together with such discussions of them as the Director may deem profitable, also crop reports from the several stations. Five hundred copies shall be printed. It shall be published in the Spanish language until January 1, 1902, and thereafter in the English language. The bulletin and report shall be published by the Manila Observatory, but the Insular Government shall pay the actual cost of paper, typesetting, presswork, and binding. The Director shall further cause such special reports and maps to be prepared from time to time as the Commission may authorize or direct. When it is deemed desirable to publish special reports or maps, the number of copies to be printed and the method of publication shall, in each case, be fixed by the Commission.

Sec. 5. The central station of the Bureau shall be the Manila Observatory. A monthly expenditure of three hundred and seventy-five dollars ($375), in money of the United States, is hereby authorized for the rental of the instruments, instrument rooms and towers, offices, library, printing room, lithographing room, and printing press of the Manila Observatory, for the type necessary to print the monthly bulletins and reports which shall be furnished by the Director, and for the maintenance of instruments.

Sec. 6. There shall be, besides the central station, nine (9) first-class s tations, twenty-five (25) second-class stations, seventeen (17) third-class stations, and twenty (20) rain stations. First-class stations shall be established and maintained at: Zamboanga, Mindanao; Cebu, on the island of Cebu; Iloilo, Panay; Ormoc, Leyte; Daet, province of Ambos Camarines, Luzon; Albay or Legaspi, province of Albay, Luzon; Baguio, province of Benguet, Luzon; Dagupan, province of Pangasinan, Luzon; and Aparri, province of Cagayan, Luzon. Second-class stations shall be established and maintained at: Jolo, on the island of Jolo; Iligan, Mindanao; Dumaguete, Eastern Negros; Loon, Bohol; Maasin, Leyte; Calbayog, Samar; Concepcion, Panay; Tacloban, Leyte; Capiz, Panay; Sorsogon, province of Sorsogon, Luzon; Pasacao, province of Ambos Camarines, Luzon; Cabo Santiaga, province of Batangas, Luzon; Atimonan, province of Tayabas, Luzon; Bacolod, in Western Negros; Mariveles or Corregidor, at the entrance to Manila Bay; Olongapo, province of Zambales, Luzon; San Isidro, province of Nueva Ecija, Luzon; Iba and Cape Bolinao, province of Zambales, Luzon; Baler, district of Principe, Luzon; Bayombong, province of Nueva Vizcaya, Luzon; Vigan, province of Ilocos Sur, Luzon; Tuguegarao, province of Cagayan, Luzon; Laoag, province of Ilocos Norte, Luzon; Cabo Bojeador, province of Ilocos Norte, Luzon. Third-class stations shall be established and maintained at: Mati, Mindanao; Cottabato, Mindanao; Davao, Mindanao; Tandag, Mindanao; Butuan, Mindanao; Caraga, Mindanao; Tuburan, Cebu; Surigao, Mindanao; San Josè de Buenavista, Panay; Palanoc, Masbate; Romblon, on the island of Romblon; Batangas, province of Batangas, Luzon; Nueva Caceras, province of Ambos Camarines, Luzon; Calapan, Mindoro; Mamburao, Mindoro; Tarlac, province of Tarlac, Luzon; and Cabo Engaño, province Cagayan, Luzon. Rain stations shall be established and maintained at: Isabela de Basilan, Basilan; Dinagat, on the island of Dinagat; Puerto Princesa, Palawan; Cuyo, on the island of Cuyo; Tagbilaran, province of Bohol; Borongan, province of Samar; San Pascual, island of Burias; Ragay, province of Ambos Camarines, Luzon; Santa Cruz, province of Laguna, Luzon; Cavite, province of Cavite, Luzon; Morong, province of Morong, Luzon; Balanga, province of Bataan, Luzon; Masinloc, province of Zambales, Luzon; Cabanatuan, province of Nueva Ecija, Luzon; Carranglan, province of Nueva Ecija, Luzon; San Fernando, province of Union, Luzon; Carig, province of Isabela, Luzon; Ilagan, province of Isabela, Luzon; Candon, province of Ilocos Sur, Luzon, and Alcala, province of Cagayan, Luzon: *Provided*, That if, as the work of establishing stations progresses, the Director shall find that, in some instance, places other than those named in this section are better suited to the requirements of the weather service, he is authorized to change the location of second-class stations, third-class stations, or rain stations, in his discretion.

Sec. 7. At the central station hourly meteorological observations shall be made, and a continuous record of meteorological phenomena shall be kept. Weather forecasts and storm warnings shall be prepared and sent as hereinbefore prescribed, and all reports shall be prepared for publication. Such other meteorological work shall be performed as the Director may require.

Sec. 8. At all first-class stations, hourly meteorological records shall be kept and compiled, and they shall be forwarded to the central station by mail at regular intervals, to be prescribed by the Director, together with monthly reports as to the state of the crops in the vicinity. Such daily telegraphic reports of the state of the weather shall be forwarded to the central station as the Director may require.

SEC. 9. At all second-class stations six daily meteorological observations shall be made at times to be specified by the Director, and the results for each month shall be compiled and forwarded to the central station before the end of the next succeeding month. Such daily telegraphic reports of the state of the weather shall be forwarded to the central station as the Director may require. Monthly crop reports shall be forwarded to the central station by mail.

SEC. 10. At all third-class stations two daily meteorological observations shall be made, at hours to be fixed by the Director. They shall be forwarded to Manila by wire, if possible, otherwise by mail. Monthly crop reports shall be forwarded by mail.

SEC. 11. At all rain stations there shall be recorded the daily maximum and minimum temperature, barometric readings at 6 a. m. and 2 p. m., and daily rainfall. Reports from rain stations shall be forwarded by mail to the central station, together with monthly crop reports.

SEC. 12. Officers or employees of the Bureau employed in the establishment of stations shall be allowed their actual and necessary traveling expenses and the actual cost of transportation of instruments, apparatus, and shelters for the same. The nine first-class stations shall be established by the Director immediately, and the other stations authorized in Section 6 as soon as practicable. Employees for the several stations shall be appointed as they are established.

SEC. 13. The officers and employees of the weather bureau shall make such observations and reports on astronomical, magnetic, and seismic phenomena as the Director may prescribe. The results of such observations may be included in the monthly reports when their publication is deemed desirable by the Director.

SEC. 14. The Director shall cause standard time to be furnished to the city of Manila at noon daily, and to all branch stations in telegraphic communication with the central station at 11 a. m., daily. He shall further provide for the free rating of all chronometers brought to the Manila Observatory for this purpose.

SEC. 15. The following sums in money of the United States are hereby appropriated for the purposes named:

(*a*) For the purchase of additional instruments and apparatus for the equipment of nine (9) first-class stations, and for suitable shelters for the same, one thousand, seven hundred and eight dollars and fifty cents ($1,708.50).

(*b*) For the erection of shelters and the installation of instruments for nine (9) first-class stations, five hundred dollars ($500.)

(*c*) For the purchase of instruments and apparatus sufficient to equip twenty-five (25) second-class stations, for shelters for the same and for cost of installation, four thousand, two hundred and fifty dollars ($4,250).

(*d*) For the purchase of instruments and apparatus sufficient to equip seventeen (17) third-class stations, and for the installation of the same, one thousand and eighty-eight dollars ($1,088).

(*e*) For the purchase of instruments and apparatus sufficient to equip twenty (20) rain stations, five hundred and twenty dollars ($520).

SEC. 16. This act shall take effect on its passage.

Enacted, May 22, 1901.

THE AUTUMN HAZE.

In reply to a letter asking the Chief of Bureau as to the nature of the haze or hazy weather called Indian Summer, the following has been sent:

The dry haze is undoubtedly due to fine particles of dust. The finest dust is composed of one or all of the following substances, namely, fine particles of soil or the dead leaves of plants, smoke, or ashes from wood fires, salt from the ocean spray, the shells or scales of microscopic silicious diatoms, germs of fungi, spores of ferns, pollen of flowers, etc. In the still air of damp nights these dust particles settle slowly down, or rapidly if they gather dew on themselves, and the morning air is comparatively clear. During the daylight the sun warms the soil which heats the adjacent air and the rising currents carry the dust up as high as they go. Up to this height the air becomes more and more dusty day after day depending on the balance between the settling by night and the rising by day. If a general wind is blowing this will bring an abundance of fresh air, and the haze is generally diminished thereby in intensity but spread over a large area of ground. If there be no general wind, as for instance in the midst of areas of high pressure (where the daytime is warm, dry, and clear), then the layer of dust reaches higher and higher each successive day; during long, dry summers in India it rises to 3,000 5,000 and 7,000 feet with a well defined upper surface that is higher in the daytime than at night-time. This is a general explanation of dry-haze weather, and applies to Indian Summer as well as to all occasional areas of high pressure. The reason why we have more of it in the autumn is because there is then less horizontal wind and less rising air. The reason for the diminished horizontal wind is probably found in the general circulation of the atmosphere. The reason for the feebler vertical ascending currents is because the surface of the ground is not then heated warm enough by the sun relative to the temperature of the air to make such strong ascending currents as occur in midsummer.

THE MOON AND THE WEATHER.

We print on page 372 an interesting letter under the above title from the venerable Levi W. Meech, of Norwich, Conn., well known to American meteorologists by his laborious work On the Relative Intensity of the Heat and Light of the Sun received by the Earth at different Latitudes, and published by the Smithsonian Institution in 1856. Mr. Meech was at that time, as he has always been, a high authority on the mathematical principles that underlie the business of the actuary of a life insurance company, and this mathematical memoir was but a side issue in his life work. The article now published shows that long since he executed a computation that would undoubtedly bring out the influence of the moon on atmospheric phenomena if it could be applied to normal values for a large number of stations representing the whole earth. The present communication illustrates the form of the result that would be given by each station, but the question as to whether all data conspire to show the existence of a lunar influence must not be inferred prematurely from the evidence furnished by one station for one year. If temperature formulæ were at hand for many stations during the period September, 1853–April, 1855, for which Mr. Meech has computed the formula for Dr. Kane's station, we should naturally compare together the different sets of coefficients of the terms containing the sine and cosine of m, as also of $2m$, $3m$, etc.; the average of all for the whole earth would show the influence of the moon. When we have but one station formula we can only ask what are the "probable errors" of the coefficients of sine and cosine m. On this point, unfortunately, Mr. Meech gives us no information.

A new journal, now published in St. Petersburg, is devoted to the exploitation of the lunar influence, and seems to assume that it must necessarily be large and important. It has lately printed a general review of the literature of the subject, but as is generally well known, every exact investigation throws doubt upon the subject whether the moon has any importance in meteorology. Perhaps the moon ought to influence the weather—but it doesn't. The controversies over this subject, waged during the 18th century, sobered down during the 19th century to the general conviction that the moon's influence is so slight that we really ought not to waste our time discussing it so long as the solar influence claims our undivided attention. It is to be hoped that dur-

ing the 20th century meteorologists will give increasing attention to the solar heat, atmospheric moisture, the rotation of the earth, and other important matters that enter into dynamic meteorology and will not revive a useless discussion as to the influence of the moon on the weather. Its real, but very slight, influence on the semimonthly atmospheric tides seems to be a matter of interest to mathematicians rather than to meteorologists. The excellent review of our knowledge of the lunar influence, given by van Bebber in the first chapter of his Handbook of Practical Meteorology, ought to suffice for the present.

METEOROLOGY IN MADAGASCAR.

As the progress of meteorology depends largely upon the maintenance of records in the out of the way places of the world and on the ocean vessels in order that we may fill up the great gaps in the daily weather map of the world, we take pleasure in the announcement that the meteorological system of Madagascar has been reestablished, with its headquarters at the mission station and observatory at Tananarivo, the capital of Madagascar. The new observatory is being rebuilt on the site of the old observatory, about a mile and a half east of the capital on the summit of a barren hill, and resumed its work in July, 1899, at least in part. So far as possible, the building stones that were overturned in the revolution of 1895 have been again utilized. The institution is still in charge of its original director, Father Colin, of the Roman Catholic Mission. This constitutes a most important station for the observation, study, and prediction of the typhoons of the southern Indian Ocean. Further details will be found in an article by W. H. Hunt in the Bulletin of the American Geographical Society, July, 1901, page 204.

POPULAR ERRORS IN METEOROLOGY AND GEOGRAPHY.

In the Bulletin of the American Geographical Society, Vol. XXXIII, No. 3, July, 1901, page 259, we find an admirable article by Mr. Henry Gannett entitled "Certain persistent errors in geography." Some of the items mentioned by him pertain specifically to meteorology, which subject is often treated as one of the children, whereas it is really the parent of the many lines of study included under the word geography. In the intellectual progress of a nation there can be nothing more important than the eradication of errors from the children's text-books, and this will never be done so long as compilers and publishers find it to their advantage to occasionally introduce popular fictions or hazy theories instead of sound knowledge. It is a very common complaint on the part of advanced students that "old legends which were taught as truths a generation or more ago still survive in the text-books, and are still accepted by the great mass of the people." It ought not to be necessary to reconcile ourselves to the idea that "still another generation will pass before the truth will filter down from geographers into the text-books and from the text-books to the people." Every school board of trustees would do well to have a committee on revision of text-books, and to insist that revised editions be furnished. He is a benefactor to the people who eradicates weeds from the farm and errors from the mind.

Although Mr. Gannett's remarks on the influence of forests on rainfall, the influence of the Japan Current, and the Gulf Stream are analogous to some that have appeared in the Monthly Weather Review, yet we think it well to reprint them as an admirable contribution to the campaign of truth against error:

"*Forests and rainfall.*—An example of the persistence of error is the idea that the presence or absence of forests has an influence upon the amount of rainfall. Some keen observer long ago detected the fact that forested regions enjoyed a a heavier rainfall than those not forested, and jumped to the conclusion that rainfall was produced by forests, and, as a corollary, that the removal of forests diminished the rainfall. Looking over the earth he found many treeless, desert, and semidesert regions, and forthwith instanced them as frightful examples of the result of man's wastefulness in destroying the the forests. Prominent among these examples are the shores of the Mediterranean, including the Iberian Peninsula, Italy, northern Africa, and Syria, which are often quoted as favorite illustrations of man's destruction of climate by his destruction of the forests.

"In reply to this charge man can certainly plead not guilty. If his accusers had possessed a little more knowledge of the causes of climate and the conditions which modify it, they would have seen at once that the geography of this Mediterranean region, the present configuration of the land and water, and the prevailing winds are such as to give it a light rainfall—forests or no forests. Furthermore, a knowledge of physiography would have taught them, in corroboration of the above, that the arid or semiarid conditions now existing must have existed for many thousands, if not millions, of years, for the mountains, cliffs, and canyons are such as are carved only in arid regions, are not those of a moist climate, and these forms have not been made in a day. The situation is simply that the cart has been placed before the horse. Want of rain prevents the growth of trees; want of trees does not prevent rain. This position is generally accepted among physical geographers but the majority of the people still reverse cause and effect.

"*Forests and floods.*—A persistent, widespread, and well-rooted error is the belief that floods in our rivers are greater and more frequent than formerly, and that this is due to the removal of forests from their drainage areas. Every great flood induces another flood of editorial paragraphs in the newspapers to the effect that man, by clearing away forests, has increased the flood height of streams, and correspondingly diminished the low water flow.

"It is probable, although it has not been proved, that the clearing of land by cutting away the forests and undergrowth, does change the regimen of streams, increasing their flood height and dimishing the flow at low stages. In other words, water probably runs off or evaporates more rapidly from bare ground than from ground which is covered with trees or other forms of vegetation. But where the forests are cut away the land is seldom left bare; it is cultivated or quickly becomes covered with bushes which hold the water quite as effectively as forests.

"The main fact, however, is that the floods in our rivers are no greater or more frequent now than in the past. The Ohio River, for instance, has been gaged continuously for many years, and these gagings show no appreciable change in regimen, whatever changes may have been made in the forest cover of its basin.

"In the school geographies we are taught that the fiords of the coast of Norway, those deep gorges partly filled by the sea, are proof that the coast has been sinking. How could such canyons be cut, it is asked, unless at the time of their construction they were above sea level? But to-day, on the coast of Alaska, we see just such canyons in course of construction below sea level. On this coast are scores of glaciers traveling in gorges, which near their lower ends are many hundred feet below the level of the sea. The Muir Glacier, where its front meets the sea, is over 800 feet thick, 600 feet of which is below the level of the water, and this, like all other glaciers, is constantly carving its bed deeper. The Nor-

wegian fiords were cut by glaciers, and, probably, while the sea and land were at the same relative levels. The coast of Norway may be sinking, but its fiords are not evidence of it.

"*Climate and ocean currents.*—Other familiar errors concern climate still more directly. The well-known mild climate of the northwest coast of America is commonly attributed to the balmy influences brought to it by the Japan Current; the Gulf Stream is supposed to have the same influence upon the west coast of Europe, and the cold climate of the east coast of the United States is attributed to the supposed current from the Arctic Ocean hugging this coast.

"That these explanations do not explain will be realized after reflection. Can it be supposed that the Japan Current, however warm it may be when it leaves the Tropics, retains any appreciable excess of heat after a journey of 6,000 miles in northern latitudes? As a matter of fact, no trace of this current reaches the shores of North America, its force being entirely lost thousands of miles to the westward. There is nothing left but the merest drift of the surface water before the prevalent west wind.

"In the North Atlantic the condition is much the same. The Gulf Stream loses its velocity and disappears as a current long before the British Isles are reached. That the cold climate of the eastern coast of the United States is caused by an Arctic current close inshore is disproved by the fact that there is no such current along this coast.

"*Winds and ocean currents.*—There is probably no phenomenon connected with the physical life of the earth which has been the object of greater misconceptions than the currents of the sea. The maps of the school books are covered with lines and arrows, indicating currents in every conceivable direction, every temporary drift of surface water reported by navigators having apparently been recorded as a current.

"The system of oceanic currents is very simple: a drift of water toward the equator, a current along it, flowing westward to the land, there dividing, flowing north and south, and dispersing.

"This equatorial current has been attributed in the text-books to a variety of causes. The unequal heating of sea water in different latitudes is a favorite explanation. This, however, could produce currents only by changing the volume of the heated water, and, unfortunately, if the water under the equator were appreciably expanded by heat, it would cause currents in the opposite direction from those which exist; we should find them flowing away from the equator instead of toward it.

"Another explanation given is the increased evaporation in the Tropics, thus lowering the surface of the water and causing an inflow from north and south. Were this of any appreciable magnitude it would undoubtedly cause a drift of water to equatorial regions, but there would be no corresponding outflow, such as the Gulf Stream and Japan Current.

"A third cause assigned is the diminution of atmospheric pressure on the sea in the Tropics, produced by the heating of the atmosphere and its consequent rarefaction. This amounts to a fraction of an inch in the barometric column, and is, therefore, a small matter. Undoubtedly, if it had an appreciable effect upon the sea, this effect would take the form of a slight flow of water toward the equator; but, when equilibrium was thus established, there would be no further flow toward the equator; nor would there be any flow at all away from it.

"Still another cause assigned is the increase in density of the water under the equator, due to excessive evaporation, thus increasing the saltness of the water. It is difficult to see what effect would thus be produced were it appreciable.

"The true cause of the ocean currents is sometimes mentioned in the text-books; but, excepting in two of the most recent ones, is given little or no prominence. The initial cause is the trade winds.[1] These blowing constantly from the northeast and southeast, induce a drift of the surface water in their directions. These two drifts meeting near the equator flow along it westwardly, developing into a well-defined equatorial current. In the Atlantic this current, after flowing across the ocean, impinges on Cape St. Roque, Brazil, where it divides. The smaller part turns southward and skirts the coast of South America, fading out near the latitude of Cape Horn. The northern, and much the larger part, flows through the Caribbean Sea and the Gulf of Mexico, gathering strength and momentum in the narrow passages through which it is forced by the body of water behind it, and enters the Atlantic through the Strait of Florida. Here in the open sea it rapidly widens, shallows, and loses its velocity, and in the middle Atlantic is reduced to a mere drift, gradually turning southward to repeat its long journey.

"What takes place in the Atlantic takes place on a much larger scale in the Pacific. From all parts of that great ocean within the Tropics the surface water is driven to the neighborhood of the equator by the trade winds. Along the equator it flows for thousands of miles in a great current. On reaching the land it divides, and the southern portion subdivides, time after time, and finally is lost among the maze of islands constituting Australasia. The northern part skirts the Japanese Islands, gradually turning to the northeast, as it gets under the influence of the prevailing westerly winds, and soon disperses in the great waste of waters of the North Pacific.

"These are the great oceanic movements. They are initiated by the winds, and their course is modified by the winds and by the shores. Besides changing the courses of the main currents, the shores and islands divide the currents, sending off numberless little minor streams of water in various directions.

"*Influence of the ocean on the land.*—The land absorbs heat rapidly, and as rapidly cools. Water, on the other hand, is heated slowly and holds its heat longer. Moreover, the sea is constantly in motion, its waves, tides, and currents—especially the latter—tending to create a uniform temperature throughout its mass. In consequence of all these conditions, the sea has a much more uniform temperature in its different parts, and at different times than the land. It is warmer in high latitudes and cooler near the equater; it is warmer in winter and cooler in summer. It follows, further, that the coasts on which the prevailing wind is from the sea, share in this amelioration of climate, while the interior of continents, and coasts on which the prevailing winds are from the land do not share in this amelioration of climate.

"Here we have the application of all that has gone before. On our northwest coast the prevailing winds are from the west, from the sea, and they bring to the coast the climate of the sea, which is warmer on an average through the year than the land, and also much warmer in winter and much cooler in summer. The coast of Europe is under similar conditions, while the east coast of the United States and of northern Asia is under reverse conditions. Here the prevailing winds still being from the west come from the land, and they give these coasts a continental or land climate, which is much colder in winter and warmer in summer. As was stated before, the cold climate of the east coast of the United States has been attributed to an arctic current flowing close inshore. If there were such a current, it could have no effect upon the climate of this coast, since the prevailing winds are from the west, and could not bring the cold of the sea to the land."

[1] The Editor will endeavor to give the fuller physical theory as established by many physicists in an early number of the Review.

FURTHER EXPLANATIONS DESIRED.

In a recent communication on "The stars and the weather" to Leslie's Weekly, Prof. Simon Newcomb, the eminent astronomer, says:

The fact is that the extraordinary changes of weather which we experience are produced almost entirely by the accidental meeting of currents of hot, cold, or moist air. High above the earth the air is in constant motion—currents or streams moving with great swiftness around the earth, in some latitudes or seasons in a westerly and in others in an easterly direction. Through the heat of the sun, water is constantly evaporated from the ocean and to a less extent from the land. The vapor rising up mixes in with the air currents and condenses into clouds which are carried along with the winds. The currents vary from time to time, and when a cold and a wet current come together we have rain. The sun shining on the earth heats it up, and the warm earth heats the air in contact with it and thus expands it; the expanded hot air tends to rise and as it does so, the air from around flows down and in and takes its place. By this change electricity is developed and thus we may have a thunderstorm. If the winds are blowing in opposite directions near the place where the volume of air rises, we may have a whirlwind or a cyclone.

Thus it is that the weather is continually changing over the greater part of the earth through the varying currents of air, without the direct action of any astronomical cause. It is true that the whole movement is kept up by the heat of the sun; but there are, so far as we know, no changes in this heat to produce changes of weather.

We think that the above quotation gives altogether too much prominence to the accidental meeting and mixture of currents of cold air and moist air. The fact that such mixtures will not produce any appreciable rain was long since demonstrated and this ancient theory was banished from reputable works on meteorology. The development of electricity by the rise of hot air and the descent of cold air is, we believe, a new thought in the physics of the atmosphere. The formation of a cyclone or a whirlwind as a consequence of winds blowing in opposite directions is another theory long since abandoned: only the smaller dust whirls are formed in this way and often not even those. "Accidental" phenomena are entirely unknown in meteorology. Everything moves according to natural laws; if events seem to be accidental it is only because of our ignorance of the workings of those laws.

In the course of a long acquaintance with this eminent astronomer we have never known him to fall into serious error in a matter of fundamental scientific principles, and as his beautiful popular style of writing contributes powerfully to the dissemination of sound knowledge, we venture to hope that he will publish some further explanation of his views for the benefit of the observers of the Weather Bureau and the readers of the Monthly Weather Review.

WEATHER BUREAU MEN AS INSTRUCTORS.

Mr. J. S. Hazen, Observer Weather Bureau, Springfield, Mo., reports that he delivered two lectures during the month. One was before teachers attending the county institute, at Springfield, and the other before teachers attending the summer sessions of the Springfield Normal School.

Both lectures were devoted mainly to a discussion of the use of weather maps in schools.

CORRIGENDA.

Monthly Weather Review for May, 1901, page 214, column 2, list of micrographs, etc., supply the following dates:

17. 1901, February 5.
18. 1898, January 5.
24. 1893, February 16.
25. 1892, January 5.
26. 1899, December 14.

Monthly Weather Review for July, 1901, make the following corrections:

In note at bottom of page 306, column 1, lines 1 and 6, for "Pockles" read "Pockels."

Page 309, column 1, line 5 from bottom, for "east" read "west."

THE WEATHER OF THE MONTH.

By Alfred J. Henry, Professor of Meteorology.

CHARACTERISTICS OF THE WEATHER FOR AUGUST

The month of August was characterized by (1) an unusually rapid movement of the highs and lows during the early part of the month, (2) a severe and destructive storm on the Gulf coast, and (3) an unusually heavy rainfall along the eastern slopes of the Appalachians. In other respects, the month was fairly typical of average August weather.

Temperature was generally above the average in all parts of the country, save over some portions of the South Atlantic States and along the immediate Pacific coast. The hot weather of the preceding month continued into August, and maximum temperatures ranging from 100° to 110° were recorded at various points in the Missouri and middle Mississippi valleys.

The rapid movement of the highs and lows across the country, which continued until about the 15th of the month, was very remarkable for the summer season. The winds were not especially boisterous and the rainfall accompanying the lows was not heavy.

PRESSURE.

The distribution of monthly mean pressure is graphically shown on Chart IV and the numerical values are given in Tables I and VI.

The distribution of monthly mean pressure differed from that of a normal month, mainly in the relative position of the south Atlantic high, the crest of the high appearing somewhat farther to the northward than usual. There was also a western extension covering the Lake region. In Tennessee and the central Gulf States, a portion of the territory usually occupied by the south Atlantic high, pressure was relatively low.

As compared with the previous month, pressure rose from .05 to .15 inch over the northern two-thirds of the country, except on the immediate Pacific coast. The maximum rise was in that part of the country where mean pressure was unusually low during July. Pressure was below the normal in the lower Ohio and lower Mississippi valleys, over Texas and a portion of the middle Pacific coast; elsewhere it was above normal by amounts ranging from .01 to .10 inch.

TEMPERATURE OF THE AIR.

The distribution of monthly mean surface temperature, as deduced from the records of about 1,000 stations, is shown on Chart VI.

The month as a whole must be classed as warm, temperature being from 2° to 4° on the average above the normal for the season, except in southern Georgia and Florida, and along the immediate Pacific coast, where slight negative departures were recorded. The hot weather of the preceding month continued into August and maximum temperatures of from 100° to 110° were registered in the Missouri and middle Mississippi valleys and the Southwest, during the first half of the month.

The average temperature for the several geographic districts, and the departures from the normal values are shown in the following table:

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	10	68.0	+ 1.4	− 0.9	− 0.1
Middle Atlantic	12	75.0	+ 1.8	+ 0.2	0.0
South Atlantic	10	79.1	+ 0.5	−10.1	− 1.3
Florida Peninsula	7	80.3	− 1.0	−13.5	− 1.7
East Gulf	7	79.9	+ 0.4	− 8.0	− 1.0
West Gulf	7	83.3	+ 2.7	+ 6.8	+ 0.8
Ohio Valley and Tennessee	12	75.9	+ 1.0	− 3.2	− 0.4
Lower Lake	8	71.3	+ 1.9	+ 1.0	+ 0.1
Upper Lake	9	67.7	+ 2.0	+10.1	+ 1.3
North Dakota	8	67.7	+ 1.2	+25.9	+ 3.2
Upper Mississippi Valley	11	75.2	+ 2.4	+15.5	+ 1.9
Missouri Valley	10	76.3	+ 3.3	+27.1	+ 3.4
Northern Slope	7	70.4	+ 2.5	+19.4	+ 2.4
Middle Slope	6	77.9	+ 3.3	+13.6	+ 1.7
Southern Slope	6	80.9	+ 2.9	+ 6.9	+ 0.9
Southern Plateau	15	76.4	+ 0.3	+ 3.5	+ 0.4
Middle Plateau	9	70.6	+ 0.9	+11.1	+ 1.4
Northern Plateau	10	71.4	+ 4.0	+11.8	+ 1.5
North Pacific	9	63.3	+ 1.2	− 7.5	− 0.9
Middle Pacific	5	64.1	− 0.7	− 2.9	− 0.4
South Pacific	4	72.0	+ 0.6	+ 3.9	+ 0.5

In Canada Prof. R. F. Stupart says:

The temperature was from 1° to 4° above average over the Lake region of Ontario, also to the same amount over a large portion of Nova Scotia and in Prince Edward Island. In British Columbia and Alberta it was just above average, whilst throughout Quebec and all the remaining portions of Canada it was from average to 2° below.

PRECIPITATION.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	10	3.52	88	−0.5	+ 0.5
Middle Atlantic	12	6.98	152	+2.4	− 0.2
South Atlantic	10	7.22	109	+0.6	+ 1.7
Florida Peninsula	7	9.09	136	+2.4	+ 5.8
East Gulf	7	6.97	130	+1.6	+ 1.0
West Gulf	7	2.74	75	−0.9	−11.0
Ohio Valley and Tennessee	12	4.95	139	+1.4	− 7.0
Lower Lake	8	3.98	134	+1.0	− 1.0
Upper Lake	9	1.86	61	−1.2	− 4.2
North Dakota	8	2.05	95	−0.1	+ 0.5
Upper Mississippi Valley	11	1.42	47	−1.6	− 7.8
Missouri Valley	10	2.11	65	−1.1	− 7.0
Northern Slope	7	1.07	86	−0.2	+ 0.9
Middle Slope	6	1.67	63	−1.0	− 5.3
Southern Slope	6	1.83	70	−0.8	− 2.9
Southern Plateau	15	2.10	124	+0.4	+ 1.3
Middle Plateau	9	1.54	285	+1.0	+ 0.8
Northern Plateau	10	0.13	30	−0.3	− 1.9
North Pacific	9	0.22	27	−0.6	0.0
Middle Pacific	5	0.02	100	0.0	− 0.8
South Pacific	4	0.07	100	0.0	+ 1.9

The month as a whole was one of abundant rainfall, although seven of the twenty-one districts into which the country is divided had less than 75 per cent of the normal amount. The districts having more than the seasonal average were the Middle Atlantic States, South Atlantic States, Florida Peninsula, eastern Gulf, Ohio valley and Tennessee, lower Lake region, Southern Plateau and the Middle Plateau. The rainfall on the Middle Plateau was especially remarkable, the total amount being 285 per cent of the normal. Especially heavy rains fell in the mountain regions of western North Carolina and southwestern Virginia. In fact, the western two-thirds of North Carolina and the eastern third of Tennessee, including portions of South Carolina and northern Georgia, received over 10 inches of rain during the month. Very heavy rains also fell in eastern Pennsylvania and southern New York and New England, while in the middle and upper Mississippi and in the Missouri valleys the total fall was slightly over 50 per cent of the normal.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 19, 23, 28. Arizona, 3, 4, 11, 12, 15, 27. Arkansas, 16. California, 4, 6, 12, 16, 17, 18. Colorado, 3, 4, 8, 10, 11, 12, 14, 15, 16, 20, 27, 28, 29, 30. Florida, 30. Georgia, 27. Idaho, 2, 20. Indiana, 26, 30. Iowa, 13, 14. Kansas, 11, 13, 20, 24, 25, 29, 30. Louisiana, 26, 28. Michigan, 6, 29. Missouri, 14, 15. Montana, 2, 15. Nebraska, 9, 10, 12, 13, 14, 24, 29. Nevada, 2, 6, 9, 15, 17, 18. New Jersey, 15. New Mexico, 8, 10, 16, 18, 19, 24, 30. New York, 8, 9. North Carolina, 1, 26, 31. North Dakota, 10, 12, 20. Ohio, 27, 29, 30, 31. Oregon, 8, 10, 18, 25, 26. Pennsylvania, 9, 31. South Dakota, 6, 9, 10, 14, 28, 29. Tennessee, 18, 26. Utah, 1, 3, 4, 10, 27. West Virginia, 20, 26. Wyoming, 8, 23, 24, 27, 30.

In Canada.—Professor Stupart says:

The rainfall was largely below the average over British Columbia and throughout the Dominion as far east, and including the Lake Superior region, also in eastern Quebec and all parts of the Maritime Provinces. Over western Quebec the average was exceeded by an inch to an inch and a half. In Ontario, south of the Ottawa River, and including the Georgian Bay and lower Lake region, the distribution of rain was in many respects remarkable, excessive and deficient amounts occurring in contiguous districts, owing to local thunderstorms. Along the north shore of Lake Erie and the west and south shores of Lake Huron there was very little rain during the month; less than half an inch in some localities. In Peterboro, Northumberland, Hastings, and Prince Edward counties the rainfall was also very light, but elsewhere there was, as a rule, a considerable quantity. The chief deficiencies reported in Canada were: Barkerville, 2.2 inches; Edmonton, 2.6 inches; Manitoba, 1.4 to 1.8 inches; White River, 2.1 inches; Chatham, N. B., 2.3 inches; Sydney, 2.0 inches; and the chief excesses, Woodstock, Ont., 3.2 inches; Orangeville, Ont., 3.5 inches; Aurora, Ont., 2.6 inches.

HUMIDITY.

The averages by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	85	+ 3	Missouri Valley	60	− 7
Middle Atlantic	80	+ 5	Northern Slope	59	+ 8
South Atlantic	84	+ 2	Middle Slope	59	− 2
Florida Peninsula	81	0	Southern Slope	56	− 8
East Gulf	81	+ 1	Southern Plateau	45	− 3
West Gulf	71	− 3	Middle Plateau	44	+12
Ohio Valley and Tennessee	76	+ 5	Northern Plateau	41	− 2
Lower Lake	75	+ 5	North Pacific Coast	70	− 8
Upper Lake	77	+ 3	Middle Pacific Coast	63	− 5
North Dakota	69	+ 6	South Pacific Coast	66	+ 3
Upper Mississippi	64	− 6			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which

also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Mobile, Ala	15	60	se.	Pensacola, Fla	15	70	sw.
Mount Tamalpais, Cal	16	53	nw.	Bridgetown, Bar	20	52	s.

SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

The averages for the various districts, with departures from the normal, are shown in the table below:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.6	+0.6	Missouri Valley	3.3	−0.8
Middle Atlantic	5.6	+0.6	Northern Slope	3.0	−0.7
South Atlantic	5.5	+0.3	Middle Slope	3.8	0.0
Florida Peninsula	6.0	+0.6	Southern Slope	3.7	−1.1
East Gulf	5.4	+0.5	Southern Plateau	2.9	−0.5
West Gulf	3.8	−0.6	Middle Plateau	3.6	+1.4
Ohio Valley and Tennessee	5.1	+0.6	Northern Plateau	3.1	+0.1
Lower Lake	5.4	+0.9	North Pacific Coast	3.3	−0.6
Upper Lake	4.9	+0.1	Middle Pacific Coast	4.1	+1.3
North Dakota	3.7	−0.2	South Pacific Coast	2.7	+0.2
Upper Mississippi	3.5	−0.6			

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 5,892 thunderstorms were received during the current month as against 5,930 in 1900 and 7,732 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 22d, 286; 20th, 282; 23d, 280.

Reports were most numerous from: Colorado, 350; New York, 273; Nebraska, 257.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: 27th to September 2d.

In Canada: Thunderstorms were reported as follows: Halifax, 26; Yarmouth, 25; Charlottetown, 1, 11, 16; Father Point, 15; Quebec, 3, 8, 23; Bissett, 15, 16; Ottawa, 22; Kingston, 30, 31; Toronto, 8, 15, 20, 22, 23, 26, 30, 31; White River, 12; Port Stanley, 15, 19, 23, 30; Parry Sound, 10, 15, 22, 30; Port Arthur, 7, 12, 13, 22, 28; Winnipeg, 10, 28; Minnedosa, 17; Qu'Appelle, 22, 28; Swift Current, 10, 27; Banff, 2, 25; Battleford, 4, 5, 8; Barkerville, 8.

DESCRIPTION OF TABLES AND CHARTS.

By ALFRED J HENRY, Professor of Meteorology.

For description of tables and charts see page 320 of REVIEW for July, 1901.

TABLE I.—*Climatological data for Weather Bureau Stations, August, 1901.*

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Mean actual, 8 a. m. + 8 p. m. ÷ 2.	Pressure, in inches: Mean reduced.	Pressure, in inches: Departure from normal.	Temperature: Mean max. + mean min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
New England.							68.0	+1.4										85	3.52	−0.5										5.6	
Eastport	76	69	74	29.97	30.06	+.09	62.0	+1.4	81	17	70	50	31	54	27	58	55	82	2.48	−1.0	9	5,462	sw.	32	s.	7	12	10	9	5.5	
Portland, Me	103	81	117	29.92	30.02	+.04	67.4	+0.6	85	17	74	55	19	61	23	63	61	83	3.26	−0.5	7	5,802	s.	33	se.	7	10	8	13	5.7	
Northfield	876	15	65	29.13	30.05	+.07	65.9	+3.0	84	21	77	43	6	55	34	61	59	85	3.02	−1.6	9	5,018	s.	25	sw.	8	1	15	15	7.1	
Boston	125	115	181	29.92	30.05	+.07	70.7	+1.6	88	24	77	59	19	64	23	65	62	78	3.25	−1.2	8	5,977	sw.	26	sw.	10	12	12	7	5.2	
Nantucket	12	43	85	30.06	30.07	+.06	68.3	+0.6	79	11	74	58	23	63	16	65	64	90	2.60	−0.6	11	7,823	sw.	29	s.	3	8	10	13	6.1	
Block Island	26	11	70	30.03	30.06	+.06	68.9	+0.9	82	11	74	55	30	64	18	66	65	91	3.82	+0.4	10	7,943	sw.	42	nw.	4	13	10	8	5.1	
Narragansett	....	10	....	....	....	....	69.6	+1.2	84	11	76	54	30	63	20	....	....	....	2.84	−1.0	8	....	sw.	....	....	....	15	9	7	....	
New Haven	106	117	140	29.98	30.04	+.08	71.5	+1.5	86	16	79	56	30	64	22	67	65	83	6.92	+1.8	8	5,143	s.	27	se.	7	14	8	9	4.8	
Mid. Atlan. States.							75.0	+1.8										80	6.93	+2.4										5.6	
Albany	97	84	113	29.94	30.01	+.06	73.0	+2.5	89	21	82	58	6	64	22	66	63	75	4.51	+0.5	14	4,624	s.	24	s.	23	8	11	12	5.9	
Binghamton	875	79	90	....	....	....	69.3	+2.1	86	22	78	47	2	60	32	....	....	....	3.76	−0.2	14	3,405	e.	22	w.	23	5	13	13	6.6	
New York	314	108	350	29.72	30.04	+.08	75.6	+3.3	88	11	82	63	6	70	20	69	66	77	6.88	+2.2	11	6,835	se.	39	se.	6	9	11	11	6.0	
Harrisburg	374	94	104	....	....	....	74.8	+2.7	90	10	82	59	29	67	23	....	....	....	2.99	−1.5	8	3,781	s.	24	sw.	15	9	10	12	5.8	
Philadelphia	117	168	184	29.92	30.04	+.02	76.9	+3.1	92	10	84	64	29	70	22	70	67	78	9.42	+5.1	10	6,309	sw.	33	sw.	15	10	11	10	5.7	
Scranton	805	111	119	29.20	30.04	+.04	71.2	....	90	10	80	50	2	62	30	65	62	76	6.88	....	15	4,024	ne.	30	nw.	10	6	9	16	6.9	
Atlantic City	52	68	76	29.99	30.04	+.05	73.6	+1.8	85	11	78	62	30	69	15	70	69	86	5.88	+1.1	9	6,617	sw.	26	sw.	7	15	11	5	3.8	
Cape May	17	47	51	30.04	30.06	+.06	73.0	−0.2	86	4	77	62	30	69	17	70	....	....	6.32	+1.6	9	4,893	s.	21	e.	6	11	15	5	4.8	
Baltimore	123	68	82	29.89	30.02	+.01	76.7	+1.8	93	10	84	61	30	70	22	70	68	77	6.73	+2.7	11	3,162	s.	21	ne.	6	8	14	9	5.5	
Washington	112	59	76	29.91	30.02	.00	76.0	+1.4	91	10	84	59	30	68	25	71	69	83	4.12	+0.1	10	3,746	s.	20	sw.	15	11	11	9	5.1	
Cape Henry	....	5	59	....	....	....	77.6	+1.2	93	11	84	66	5	71	20	....	....	....	10.90	+5.4	14	7,295	s.	39	n.	5	13	10	8	5.2	
Lynchburg	681	83	88	29.30	30.01	.00	75.2	−0.1	92	11	84	60	2	66	29	69	67	83	12.36	+8.4	17	2,259	se.	21	ne.	24	7	14	10	5.9	
Norfolk	91	102	111	29.95	30.04	+.04	78.3	+1.7	92	11	85	65	31	72	20	73	71	85	9.92	+3.8	13	6,047	s.	26	nw.	24	9	15	7	5.2	
Richmond	144	82	90	....	....	....	77.4	....	93	11	86	64	2	69	22	....	....	....	6.90	....	14	3,483	s.	20	nw.	1	6	15	10	5.6	
S. Atlantic States.							79.1	+0.5										84	7.22	+0.6										5.5	
Charlotte	773	68	76	29.22	30.01	+.02	76.6	+0.5	90	10	85	63	2	69	26	70	68	83	10.66	+5.3	22	3,783	s.	23	ne.	24	5	10	16	6.9	
Hatteras	11	17	36	30.05	30.06	+.07	79.5	+2.1	86	9	84	70	22	75	15	75	73	84	3.87	−2.5	16	7,592	s.	33	s.	6	15	12	4	3.9	
Kittyhawk	8	12	30	....	....	....	79.1	+1.5	89	*	84	68	26	74	18	....	....	....	5.64	−1.2	9	7,963	sw.	....	....	....	18	6	7	4.3	
Raleigh	376	93	101	29.65	30.04	+.05	78.0	+2.3	91	11	86	65	2	70	24	72	70	84	11.21	+5.0	18	3,428	sw.	22	w.	6	7	15	9	5.7	
Wilmington	78	82	90	29.96	30.04	+.05	78.6	+0.4	89	5	85	68	2	72	17	74	73	86	6.82	−0.6	17	4,791	s.	29	sw.	6	5	16	10	5.6	
Charleston	48	14	92	29.98	30.03	+.04	80.6	+0.1	88	11	85	72	2	76	13	75	73	81	4.95	−2.7	15	6,348	s.	40	ne.	25	2	26	3	5.7	
Columbia	351	114	122	29.66	30.02	+.02	79.1	−0.7	92	4	88	66	31	70	24	72	70	84	7.76	+0.9	16	4,629	se.	34	sw.	5	4	23	4	5.6	
Augusta	180	89	103	29.82	30.01	+.02	79.4	0.0	92	9	87	66	28	71	22	73	72	84	8.68	+3.5	18	8,757	se.	36	sw.	19	7	17	7	5.9	
Savannah	65	79	89	29.95	30.01	+.01	79.8	−0.5	89	10	86	66	25	73	20	75	73	87	6.44	−1.3	15	4,605	s.	27	ne.	25	6	20	5	5.2	
Jacksonville	43	69	84	29.97	30.02	+.04	80.5	−0.6	93	8	89	68	31	72	21	74	72	84	6.12	−0.4	21	5,293	se.	36	sw.	16	7	14	10	5.8	
Florida Peninsula.							80.5	−1.6										81	8.63	+2.2										6.0	
Jupiter	28	13	55	29.96	29.99	+.02	80.0	−1.0	90	31	86	69	17	74	19	76	75	84	12.13	+7.0	21	6,234	se.	33	se.	10	7	18	6	5.5	
Key West	22	43	50	29.97	29.99	+.08	81.2	−2.7	88	8	86	69	11	76	19	76	73	76	5.75	+1.0	19	5,351	se.	36	sw.	11	10	15	6	5.2	
Tampa	34	60	67	29.95	29.99	+.02	80.4	−1.0	92	9	88	70	18	73	20	74	73	84	8.08	−1.4	20	3,837	ne.	32	s.	5	0	20	11	7.2	
East Gulf States.							79.9	+0.4										81	6.97	+1.6										5.4	
Atlanta	1,174	190	216	28.79	29.99	.00	76.0	−0.5	91	9	84	65	28	68	23	69	67	81	9.83	+5.1	19	5,594	se.	43	se.	16	5	19	7	6.1	
Macon	370	93	99	....	....	....	78.9	....	93	10	88	64	4	70	24	....	....	....	3.95	....	18	3,570	s.	38	s.	5	8	12	11	5.8	
Pensacola	56	78	90	....	....	....	81.0	+0.6	93	3	87	69	28	75	18	....	....	....	6.53	−1.8	16	7,148	ne.	70	sw.	15	7	15	9	5.8	
Mobile	57	88	96	29.89	29.95	−.02	80.4	+0.1	96	2	88	69	29	73	23	74	72	83	9.77	+2.9	15	4,926	sw.	60	se	15	11	10	10	5.7	
Montgomery	223	100	112	29.73	29.96	−.02	79.9	+0.1	93	9	89	66	29	71	24	72	70	78	6.91	+2.8	8	3,971	se.	36	sw.	14	10	13	8	5.3	
Meridian	375	84	93	....	....	....	78.7	+0.9	97	3	88	63	3	69	34	....	....	....	6.55	+2.7	15	3,432	sw.	36	n.	16	13	10	8	4.8	
Vicksburg	247	65	76	29.67	29.93	−.05	80.8	+0.7	94	4	90	67	27	72	22	73	71	80	3.41	−0.1	11	3,725	sw.	23	e.	13	10	14	7	4.8	
New Orleans	51	88	121	29.88	29.94	−.02	82.2	+0.7	96	2	89	70	28	75	23	75	73	82	5.80	−0.3	15	5,330	sw.	49	ne.	15	6	19	6	5.2	
Port Eads	....	27	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	
West Gulf States.							83.3	+2.7										71	2.74	−0.9										3.8	
Shreveport	249	77	84	29.68	29.94	−.03	82.8	+1.5	99	18	93	67	27	73	25	74	71	75	3.73	+1.5	10	3,542	n.	26	w.	12	18	7	6	4.0	
Fort Smith	457	79	94	29.45	29.92	−.02	82.2	+4.5	101	25	94	64	7	70	33	71	67	68	0.58	−3.2	3	4,325	e.	25	nw.	30	13	17	1	3.2	
Little Rock	357	93	100	29.56	29.93	−.04	81.0	+2.8	100	3	91	65	7	71	27	71	68	71	1.38	−2.8	5	3,900	ne.	48	ne.	21	11	16	4	4.3	
*Corpus Christi	18	48	53	29.90	29.92	−.04	83.8	+2.4	98	15	90	74	25	77	21	77	75	79	2.53	−0.6	6	7,178	se.	24	se.	21	23	8	0	2.1	
Fort Worth	670	106	114	29.21	29.90	−.04	85.5	....	108	28	71	67	24	74	33	71	64	58	1.29	....	5	6,200	e.	36	se.	27	14	13	4	4.0	
Galveston	54	106	112	29.84	29.89	−.06	83.9	+0.7	95	15	89	70	21	79	18	77	75	79	6.58	+1.0	10	6,574	s.	27	sw.	22	15	10	6	4.5	
Palestine	510	73	79	29.39	29.92	−.05	83.5	+3.1	99	17	94	70	1	74	26	73	70	71	3.45	+0.8	4	4,269	s.	26	ne.	20	19	8	4	3.6	
San Antonio	701	67	77	29.19	29.91	−.03	85.8	+3.6	103	*	98	71	22	73	31	72	67	64	0.96	−2.9	8	4,154	se.	38	n.	30	11	18	2	4.4	
Ohio Val. & Tenn.							75.9	+1.0										76	4.95	+1.4										5.1	
Chattanooga	762	106	112	29.19	30.00	.00	75.9	0.0	98	3	84	62	2	67	33	69	66	80	9.67	+5.9	21	4,140	se.	37	se.	16	7	14	10	5.8	
Knoxville	1,004	10	88	28.96	30.00	−.02	75.2	+0.4	97	3	84	59	2	66	30	68	67	85	10.48	+6.4	22	4,064	ne.	38	s.	27	6	13	12	6.1	
Memphis	397	140	154	29.54	29.95	−.03	79.2	+0.5	102	3	88	63	6	71	25	72	69	77	6.78	+3.2	9	5,555	sw.	39	nw.	23	8	16	7	5.2	
Nashville	546	128	134	29.41	29.98	.00	76.4	−1.1	99	3	85	64	2	68	28	69	66	78	8.24	+4.8	16	4,049	se.	30	ne.	16	13	7	11	5.5	
Lexington	989	75	102	....	....	....	74.0	+0.1	92	10	82	61	7	66	25	....	....	....	3.74	+0.2	17	5,542	s.	37	se.	27	10	16	5	5.0	
Louisville	525	114	136	29.42	29.98	+.01	77.8	+1.5	97	8	88	62	6	68	32	67	63	70	2.86	−0.7	7	5,082	s.	30	n.	26	13	9	9	4.8	
Evansville	434	72	82	....	....	....	77.2	....	95	9	87	60	6	68	28	....	....	....	2.07	....	9	4,315	ne.	23	ne.	26	22	2	7	2.7	
Indianapolis	822	154	164	29.12	29.97	−.04	75.2	+1.6	95	8	85	58	6	65	29	66	62	67	3.57	+0.3	8	5,947	n.	32	se.	17	7	18	6	5.3	
Cincinnati	628	152	157	29.33	29.98	−.02	76.6	+1.6	98	9	85	62	5	68	28	67	63	69	0.88	−2.8	9	4,553	se.	36	se.	27	7	16	8	5.4	
Columbus	824	87	100	29.14	29.99	.00	74.6	+2.3	94	9	84	56	5	66	30	66	62	72	1.71	−1.5	8	5,120	s.	30	ne.	30	8	11	12	5.8	
Pittsburg	842	116	123	29.12	29.99	−.02	75.0	+2.2	93	9	84	58	5	66	27	67	63	72	4.04	+0.9	12	3,483	sw.	30	s.	22	13	12	6	4.8	
Parkersburg	638	77	84	29.35	30.02	−.01	75.2	+1.6	95	10	85	58	5	68	31	67	64	74	2.44	−1.6	13	3,188	s.	24	w.	10	10	15	6	4.8	
Elkins	1,940	41	50	28.03	30.03	+.01	70.0	....	89	9	81	50	2	59	34	63	61	87	4.23	....	17	1,979	n.	22	n.	24	5	20	6	5.7	
Lower Lake Region.							71.3	+1.9										75	3.38	+1.0										5.4	
Buffalo	767	178	206	29.20	30.01	+.03	71.5	+3.0	89	14	79	57	5	64	22	64	61	73	2.07	−1.1	13	7,252	sw.	39	sw.	8	4	13	14	6.9	
Oswego	335	76	87	29.66	30.02	+.02	69.2	+1.0	88	22	76	56	13	62	25	64	61	78	4.90	+2.3	12	5,510	s.	28	sw.	22	7	15	9	5.5	
Rochester	523	81	90	29.47	30.02	+.03	70.2	+1.8	89	22	79	53	9	62	28	64	61	77	2.19	−0.9	11	4,512	sw.	29	sw.	8	12	13	6	4.7	
Erie	713	92	102	29.26	30.00	+.01	71.1	+1.6	87	22	78	56	2	64	23	65	62	76	5.87	+2.1	13	5,857	s.	26	sw.	10	10	10	11	5.6	
Cleveland	762	190	201	29.21	30.00	.00	71.2	+1.6	92	9	77	56	5	65	27	65	62	74	6.31	+3.2	11	8,568	se.	42	nw.	3	9	12	10	5.5	
Sandusky	629	62	70	29.33	29.99	−.01	73.2	+2.2	95	9	80	60	2	66	28	66	63	75	3.93	+0.8	7	5,164	ne.	24	nw.	10	6	13	12	6.0	
Toledo	628	123	127	29.34	30.00	−.01	72.4	+1.6	94	9	81	55	5	64	34	65	61	72	3.91	+1.2	7	5,818	ne.	28	sw.	9	12	13	6	4.6	
Detroit	730	160	190	29.23	29.99	−.01	71.9	+2.2	88	15	80	56	11	64	24	65	61	73	3.20	+0.5	10	6,594	ne.	28	w.	10	10	15	6	4.6	
Upper Lake Region.							67.7	+2.0										77	1.86	−1.2										4.9	
Alpena	609	63	80	29.38	30.02	+.03	64.2	+0.7	87	13	72	48	4	56	29	61	58	81	2.25	−1.2	13	5,410	se.	41	nw.	29	13	6	12	5.3	
Escanaba	612	43	57	29.36	30.01	+.04	65.7	+1.1	81	20	74	48	4	57	25	62	59	80	3.24	−0.6	9	5,757	s.	31	n.	30	15	9	7	4.4	
Grand Haven	632	55	92	29.34	30.00	+.02	67.7	+0.7	87	17	76	51	11	59	28	63	60	76	0.42	−2.2	9	6,154	nw.	27	s.	2	13	8	10	5.1	
Houghton	668	66	74	....	....	....	65.2	....	86	6	74	45	31	56	31	....	....	....	2.60	....	12	4,479	nw.	24	se.	9	19	7	5	3.6	
Marquette	734	79	116	29.23	30.00	+.01	65.7	+2.1	84	28	72	52	10	60	24	61	58	77	2.81	−0.6	12	6,838	nw.	33	sw.	28	17	8	6	4.2	
Port Huron	638	70	120	29.35	30.02	+.04	69.8	+2.8	89	14	78	50	12	61	28	64	60	76	0.54	−2.0	9	6,794	ne.	33	nw.	7	9	10	12	5.7	
Sault Ste. Marie	614	40	61	29.34	29.99	.00	64.1	+3.3	84	20	73	47	5	55	29	59	57	80	3.01	+0.2	8	4,295	e.	29	nw.	8	16	9	6	4.3	
Chicago	823	241	274	29.14	30.00	+.02	71.6	+0.7	90	9	77	58	11	66	27	65	62	77	2.00	−1.0	7	10,233	ne.	44	s.	2	9	15	7	4.9	
Milwaukee	681	124	142	29.30	30.02	+.03	71.0	+2.7	89	7	79	56	31	63	27	65	62	79	1.50	−1.2	8	6,791	n.	33	n.	26	8	11	12	6.1	
Green Bay	617	49	57	29.36	30.02	+.01	69.5	+2.8	90	28	80	49	31	59	30	62	58	72	1.58	−1.3	7	4,686	se.	24	sw.	25	8	14	9	6.0	
Duluth	702	95	115	29.25	29.99	+.03	67.8	+3.1	87	16	74	52	8	61	24	60	56	72	1.70	−1.6	10	6,230	ne.	32	nw.	13	7	19	5	4.8	
North Dakota.							63.5	+2.1										69	1.23	−0.7										3.7	
Moorhead	935	54	60	29.00	29.98	+.04	68.4	+3.2	96	20	81	46	30	56	37	61	58	76	1.94	−0.7	8	5,859	nw.	34	se.	1	16	7	8	4.1	
Bismarck	1,074	16	29	28.25	29.97	+.05	69.8	+2.3	98	27	82	47	7	57	37	60	55	66	1.01	−1.0	4	5,767	e.	36	nw.	8	18	11	2	3.5	
Williston	1,875	15	31	28.03	29.96	+.06	67.4	+0.9	99	26	82	39	7	52	42	58	52	64	0.74	−0.4	4	5,201	n.	36	ne.	23	23	7	1	3.4	

TABLE I.—*Climatological data for Weather Bureau Stations, August,* 1901—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Mean actual, 8 a. m. + 8 p. m. ÷ 2.	Pressure, in inches: Mean reduced.	Pressure, in inches: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. + mean min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
Upper Mis. Valley.							75.2	+ 2.4										64	1.42	− 1.6										3.5	
Minneapolis	......	99	208	......	......	......	72.2	+ 3.1	93	20	83	48	31	62	31	....	....	....	2.65	− 0.5	7	7,469	s.	48	nw.	25	14	13	4	....	
St. Paul	837	114	124	29.11	29.98	+ .01	72.2	+ 3.1	94	20	82	49	31	62	31	62	56	64	2.08	− 1.2	8	4,504	se.	23	nw.	2	16	12	3	3.9	
La Crosse	714	70	78	......	......	......	72.0	+ 1.9	92	20	84	49	31	60	33	....	....	....	0.93	− 2.3	7	3,699	s.	20	nw.	2	18	11	2	2.9	
Davenport	606	71	79	29.34	29.98	− .01	74.2	+ 1.4	92	14	85	52	31	64	28	64	59	64	0.46	− 3.1	5	4,308	ne.	23	se.	17	16	11	4	3.4	
Des Moines	861	84	88	29.10	30.01	+ .04	75.0	+ 3.0	95	21	87	56	31	63	33	65	60	63	0.67	− 2.6	7	4,203	ne.	20	se.	8	13	15	3	4.4	
Dubuque	698	101	109	29.27	30.00	+ .01	73.6	+ 2.0	92	13	85	52	31	63	31	62	56	59	0.25	− 2.9	5	4,221	nw.	28	nw.	2	20	7	4	3.4	
Keokuk	614	63	78	29.33	29.96	− .02	77.2	+ 2.7	96	2	89	56	31	66	29	65	60	61	0.15	− 2.7	1	4,136	ne.	26	ne.	17	21	9	1	2.5	
Cairo	356	87	93	29.59	29.96	− .01	77.0	0.0	97	3	85	64	5	69	26	70	67	78	3.83	+ 1.0	12	4,283	ne.	35	ne.	23	16	9	6	4.0	
Springfield, Ill	644	82	93	29.32	29.98	− .02	75.8	+ 2.4	99	2	88	55	31	64	32	65	59	64	2.92	+ 0.6	6	5,272	ne.	25	nw.	2	13	13	5	4.6	
Hannibal	534	75	110	......	......	......	77.6	+ 3.4	98	2	89	57	6	66	36	....	....	....	0.89	− 1.1	2	4,998	ne.	33	ne.	17	19	11	1	3.1	
St. Louis	567	111	210	29.37	29.96	− .01	80.0	+ 3.2	105	2	90	63	31	70	32	67	60	58	0.76	− 2.7	6	5,689	ne.	30	e.	26	20	6	5	3.1	
Missouri Valley.							76.3	+ 3.3										60	2.11	− 1.1										3.3	
Columbia	784	4	84	......	......	......	78.8	+ 2.8	102	25	92	59	7	65	35	....	....	....	1.67	− 1.1	6	4,441	ne.	21	nw.	2	20	6	5	3.6	
Kansas City	963	78	95	28.99	29.97	.00	79.3	+ 3.6	101	25	90	60	4	69	31	66	60	56	2.64	− 1.3	8	4,217	ne.	24	n.	3	19	9	3	3.1	
Springfield, Mo	1,324	100	103	28.59	29.94	− .03	78.6	+ 4.6	98	2	89	60	6	68	27	67	60	59	3.03	− 1.0	8	5,295	ne.	26	n.	10	23	7	1	2.6	
Topeka	......	81	....	......	......	......	78.6	+ 3.8	105	25	90	60	4	67	34	....	....	....	1.67	− 2.8	5	......	se.	....	......	...	16	12	3	3.1	
Lincoln	1,189	75	84	28.73	29.95	− .01	76.4	+ 2.8	102	1	89	55	23	64	34	65	59	62	1.02	− 2.1	9	5,823	se.	40	se	11	20	8	3	3.3	
Omaha	1,105	115	121	28.82	29.95	− .01	76.7	+ 3.0	99	1	88	58	4	66	31	64	58	59	0.65	− 2.7	6	4,279	se.	24	ne.	3	13	13	5	4.2	
Valentine	2,598	39	40	27.31	29.94	− .01	73.0	+ 2.7	103	1	86	52	4	60	39	61	56	63	2.49	+ 0.4	13	7,075	s.	38	n.	14	16	13	2	3.4	
Sioux City	1,135	96	164	......	......	......	74.4	+ 2.8	102	1	86	53	23	62	36	....	....	....	1.75	− 2.0	9	7,016	se.	30	nw.	9	18	11	2	3.1	
Pierre	1,572	43	50	28.33	29.94	.00	75.2	+ 2.4	103	1	88	55	19	63	35	63	56	58	3.23	+ 1.6	13	5,462	se.	42	w.	20	15	12	4	3.5	
Huron	1,306	56	67	28.61	29.97	+ .02	72.6	+ 4.2	108	1	86	50	30	59	41	62	56	63	2.50	− 0.1	7	7,369	se.	36	se.	5	16	13	2	3.5	
Yankton	1,233	52	58	......	......	......	75.4	+ 3.6	105	1	87	54	23	63	34	....	....	....	2.55	− 0.6	5	4,749	e.	28	e.	10	23	8	0	2.4	
Northern Slope.							70.4	+ 2.5										59	1.07	− 0.2										4.0	
Havre	2,505	46	47	27.37	29.92	+ .01	69.2	+ 3.6	96	15	84	41	23	54	43	57	50	57	0.60	− 0.8	2	5,567	ne.	40	nw.	8	18	12	1	3.0	
Miles City	2,371	42	50	27.48	29.88	− .02	73.2	+ 1.5	100	10	87	50	29	59	38	67	64	78	0.76	− 0.3	4	3,693	n	30	nw.	26	19	10	2	3.1	
Helena	4,110	88	93	25.86	29.92	+ .02	68.8	+ 2.3	92	15	81	49	28	56	34	53	40	42	0.17	− 0.5	3	5,509	sw.	36	sw.	18	11	13	7	4.8	
Kalispell	2,965	45	51	26.94	29.95	+ .04	65.7	......	91	15	81	42	28	50	44	52	42	52	0.14	......	3	4,372	w.	35	nw.	2	21	7	3	2.7	
Rapid City	3,234	46	50	26.67	29.90	.00	71.6	+ 1.7	96	16	84	53	3	59	39	59	53	59	2.52	+ 1.2	16	5,163	w.	48	s.	26	16	12	3	3.7	
Cheyenne	6,088	56	64	24.15	29.94	+ .05	67.3	+ 2.3	93	1	81	47	21	53	38	53	46	58	0.83	− 0.7	9	6,349	nw.	45	nw.	23	7	17	7	5.0	
Lander	5,372	26	36	24.74	29.96	+ .06	68.0	+ 3.1	92	5	84	44	25	52	44	54	46	55	0.58	− 0.2	6	3,074	sw.	28	sw.	16	13	13	5	4.4	
North Platte	2,821	43	52	27.13	29.97	+ .04	74.4	+ 3.0	98	1	87	50	4	62	36	64	60	69	2.00	− 0.4	12	5,953	se.	32	s.	27	12	15	4	5.1	
Middle Slope.							77.9	+ 3.3										59	1.67	− 1.0										3.8	
Denver	5,291	79	151	24.84	29.95	+ .08	73.0	+ 2.9	100	1	87	53	21	59	38	57	50	55	1.30	− 0.2	10	5,386	sw.	38	nw.	28	11	15	5	4.5	
Pueblo	4,685	80	86	25.37	29.94	+ .04	74.2	+ 1.9	95	25	88	55	16	60	37	60	54	61	1.31	− 0.8	9	4,504	nw.	36	nw.	10	14	16	1	3.5	
Concordia	1,398	42	47	28.53	29.96	.00	79.0	+ 4.6	101	1	91	57	5	67	35	67	62	62	1.66	− 1.2	7	4,047	se.	28	n.	11	11	16	4	4.4	
Dodge	2,509	44	52	27.40	29.91	.00	78.5	+ 3.3	102	25	92	59	5	65	35	65	58	60	0.71	− 2.2	7	6,773	se.	36	ne.	13	20	10	1	3.4	
Wichita	1,358	78	85	28.57	29.94	+ .02	80.6	+ 4.1	104	25	93	59	5	68	31	67	60	57	2.00	− 1.6	6	4,095	ne.	27	n.	11	16	13	2	3.1	
Oklahoma	1,214	54	62	28.68	29.92	.00	82.0	+ 3.0	104	26	94	64	6	70	31	68	62	60	3.03	− 0.1	6	4,938	s.	26	ne.	29	16	12	3	4.0	
Southern Slope.							80.6	+ 4.0										56	1.92	− 0.8										3.7	
Abilene	1,738	45	54	28.14	29.89	− .05	84.8	+ 4.6	103	27	96	66	21	74	33	68	60	50	0.81	− 1.8	3	4,838	se.	48	nw.	21	13	11	7	4.1	
Amarillo	3,676	54	61	26.30	29.92	− .01	76.4	+ 3.5	96	27	88	60	4	65	29	64	57	61	3.08	+ 0.1	11	8,827	se.	41	nw.	30	19	11	1	3.3	
Southern Plateau.							79.1	+ 1.0										45	1.20	0.0										2.9	
El Paso	3,762	10	110	26.17	29.86	+ .01	82.1	+ 3.1	99	6	95	64	25	70	31	63	53	45	0.34	− 1.5	4	6,612	e.	42	se.	10	10	20	1	4.1	
Santa Fe	7,013	47	50	23.41	29.95	+ .05	68.8	+ 2.5	85	3	80	51	31	58	28	55	48	55	3.04	+ 0.4	12	4,454	ne.	28	nw.	14	14	16	1	3.5	
Flagstaff	6,907	12	25	23.46	30.02	......	66.3	− 0.1	86	11	80	44	21	52	36	55	...	....	1.52	+ 0.1	15	.	nw.	....	......	...	0	19	12	....	
Phoenix	1,108	47	57	28.67	29.78	− .01	89.8	+ 1.6	110	26	103	70	13	76	35	70	60	43	1.73	+ 0.8	8	3,060	w	38	ne.	10	19	10	2	3.1	
Yuma	141	16	50	29.61	29.75	.00	90.6	− 0.1	110	26	104	67	23	77	37	72	64	48	0.22	− 0.1	2	4,381	sw.	27	se.	3	28	3	0	1.0	
Independence	3,910	51	58	25.97	29.79	+ .02	76.9	− 0.7	98	11	90	57	31	64	32	58	41	33	0.32	+ 0.1	5	5,424	se.	36	se.	3	18	13	0	2.9	
Middle Plateau.							72.8	+ 1.0										44	1.28	+ 0.8										3.6	
Carson City	4,720	82	92	25.30	29.92	+ .08	68.4	+ 1.6	93	3	85	42	21	52	43	54	44	49	0.38	+ 0.2	3	4,059	w.	26	sw.	31	22	6	3	2.2	
Winnemucca	4,344	59	70	25.61	29.84	.00	70.5	− 0.1	95	3	87	42	31	54	44	54	40	38	1.16	+ 1.1	7	5,525	w.	39	nw.	7	18	3	10	3.8	
Modena	5,479	10	38	24.67	29.95	......	71.2	......	95	11	87	43	31	56	42	54	42	46	1.17	......	10	7,275	sw.	42	sw.	3	18	12	1	2.9	
Salt Lake City	4,366	105	110	25.64	29.88	+ .02	76.0	+ 1.4	95	13	88	56	20	64	35	58	45	39	1.22	+ 0.5	11	4,306	se.	30	w.	8	18	7	6	3.8	
Grand Junction	4,608	43	51	25.42	29.89	+ .03	76.4	+ 1.3	100	1	90	56	31	63	36	59	49	48	2.36	+ 1.2	15	3,699	e.	30	sw.	8	15	10	6	5.3	
Northern Plateau.							73.9	+ 3.7										41	0.09	− 0.2										3.1	
Baker City	3,471	53	58	26.44	29.91	− .03	70.0	+ 3.9	94	14	84	44	27	55	37	52	37	36	0.24	+ 0.1	3	4,266	s.	20	e.	15	19	6	6	3.2	
Boise	2,739	61	68	27.11	29.85	− .03	76.4	+ 4.2	104	13	92	49	27	60	47	56	42	34	0.02	− 0.2	2	2,996	se.	21	sw.	7	20	10	1	2.7	
Lewiston	757	52	61	......	......	......	78.2	......	107	23	95	53	9	61	45	....	....	....	0.02	......	1	2,488	e.	27	nw.	26	23	7	1	2.5	
Pocatello	4,482	46	54	25.51	29.88	− .02	73.0	+ 3.4	94	4	87	47	28	59	40	55	43	41	0.19	− 0.2	7	6,386	se.	34	sw.	20	12	13	6	4.6	
Spokane	1,943	99	107	27.94	29.92	+ .01	72.7	+ 3.7	99	15	88	50	30	57	41	55	42	41	0.01	− 0.3	1	3,162	e.	33	sw.	7	18	10	3	2.9	
Walla Walla	1,000	65	73	28.86	29.88	− .04	77.6	+ 3.4	102	5	92	54	27	64	38	64	56	52	0.01	− 0.2	1	3,734	s.	24	sw.	26	19	12	0	2.8	
N. Pac. Coast Reg.							63.3	+ 1.2										70	0.22	− 0.6										3.3	
Neah Bay	50	7	52	29.98	30.04	+ .01	57.2	− 1.7	74	13	64	46	17	51	24	54	52	87	0.24	− 2.0	2	4,591	w.	24	sw.	16	19	5	7	3.8	
Port Crescent	259	14	20	......	......	......	58.4	+ 1.7	88	14	69	40	17	48	39	....	....	....	0.03	− 0.7	1	2,946	w.	14	w.	7	19	9	3	3.5	
Seattle	123	114	121	29.91	30.04	+ .01	65.7	+ 2.5	87	15	76	50	17	55	28	58	53	69	0.13	− 0.4	2	2,641	w.	17	nw.	4	19	9	3	2.9	
Tacoma	213	113	120	......	......	......	64.2	+ 2.6	88	6	75	48	28	54	32	....	....	....	0.32	− 0.4	1	3,285	n.	17	n.	22	19	8	4	3.7	
Astoria	20	57	64	......	......	......	60.0	− 2.2	84	14	67	49	10	53	28	....	....	....	0.06	− 1.0	2	......	sw.	...	......	...	16	9	6	3.9	
Portland, Oreg	154	203	213	29.83	29.99	− .03	68.4	+ 2.5	94	14	80	50	28	57	33	60	54	65	0.17	− 0.4	1	6,302	nw.	27	nw.	13	20	7	4	3.0	
Roseburg	518	56	67	29.40	29.95	− .06	69.4	+ 3.2	101	4	84	46	24	54	43	58	51	60	0.58	+ 0.4	3	2,727	nw.	18	n.	2	23	6	2	2.0	
Mid. Pac. C'st Reg.							64.1	− 0.7										63	0.02	0.0										4.1	
Eureka	62	60	69	29.93	29.99	− .02	55.0	− 1.5	65	25	59	48	12	51	15	52	50	87	T.	− 0.1	0	3,425	nw.	15	nw.	19	5	14	12	6.3	
Mount Tamalpais	2,375	11	18	27.51	29.92	− .02	70.0	......	94	3	77	44	22	63	31	54	42	44	0.03	......	1	9,875	w.	53	nw.	26	26	4	1	1.3	
Red Bluff	332	50	56	29.50	29.85	+ .01	81.6	+ 0.5	111	3	96	55	22	67	35	61	47	35	0.00	0.0	0	3,360	se.	20	n.	11	26	5	0	1.0	
Sacramento	69	106	117	29.79	29.86	+ .01	72.6	− 0.1	105	11	87	50	22	58	39	61	53	58	T.	0.0	0	6,738	s.	24	sw.	21	24	5	2	1.9	
San Francisco	155	161	167	29.79	29.95	+ .03	56.4	− 2.3	72	1	61	49	4	52	18	55	54	93	T.	0.0	0	9,729	sw.	36	sw.	9	10	11	10	5.2	
Point Reyes Light	......	12	16	......	......	......	54.9	0.0	90	11	61	47	3	49	42	....	....	....	0.08	− 0.1	1	10,281	nw.	....	......	...	1	4	26	8.8	
S. Pac. Coast Reg.							72.0	+ 0.6										66	0.07	0.0										2.7	
Fresno	330	67	70	29.48	29.82	.00	82.4	+ 0.7	110	3	99	53	31	66	41	61	44	32	T.	0.0	0	4,640	nw.	17	nw.	16	26	4	1	1.7	
Los Angeles	338	74	82	29.54	29.89	+ .01	71.4	+ 1.0	96	26	83	49	30	60	34	62	58	77	0.09	+ 0.1	1	3,469	w.	15	w.	17	10	21	0	3.4	
San Diego	87	94	102	29.79	29.89	.00	68.2	− 0.7	79	26	72	58	31	64	15	64	61	82	T.	− 0.1	0	4,427	nw.	23	nw.	23	27	2	2	2.4	
San Luis Obispo	201	10	46	29.74	29.96	+ .06	66.0	+ 1.2	92	26	78	46	24	54	40	57	53	73	0.18	+ 0.2	1	3,158	w.	18	n.	26	22	8	1	3.3	
West Indies.																															
Basseterre	29	41	54	29.94	29.97	......	81.6	......	88	20	87	71	21	76	16	76	73	76	3.47	......	23	7,384	e.	27	se.	20	14	17	0	4.3	
Bridgetown	30	57	65	29.91	29.94	......	80.6	+ 1.6	89	15	87	71	22	74	15	76	74	80	14.96	+ 8.5	21	5,879	e.	52	s.	20	14	6	11	5.3	
Cienfuegos	52	62	67	29.91	29.96	......	81.2	......	94	7	89	71	5	73	19	74	73	82	2.78	......	15	4,415	ne.	20	ne.	3	3	21	2	4.8	
Grand Turk	11	6	20	......	......	......	83.4	......	92	9	90	70	24	77	19	....	....	....	5.05	......	13	......	se.	...	......	...	0	23	8	6.3	
Havana	57	87	105	29.91	29.97	......	81.0	− 1.2	92	17	88	69	30	74	18	76	75	86	6.63	+ 0.6	13	6,070	e.	43	e.	17	6	15	10	5.9	
Kingston	286	38	52	29.63	29.93	......	80.0	......	94	16	88	70	30	72	20	74	71	80	2.44	......	12	4,193	ne.	26	se.	11	3	24	4	5.8	
Port of Spain	40	65	66	29.89	29.93	......	79.6	......	90	2	86	71	2	73	19	75	73	82	8.15	......	26	2,644	e.	19	s.	8	3	11	17	7.4	
Puerto Principe	352	55	62	29.63	29.97	......	81.0	......	93	10	90	68	1	72	23	75	73	86	2.50	......	13	4,881	ne.	28	se.	14	8	20	3	5.1	
Roseau	25	37	47	29.92	29.94	......	81.4	......	91	15	88	72	29	75	16	74	71	74	11.12	......	27	3,992	ne.	29	se.	20	14	8	9	4.9	
San Juan	82	48	90	29.90	29.98	......	81.2	......	91	7	87	70	22	75	17	76	74	80	8.59	+ 2.7	21	8,173	e.	34	e.	19	10	11	10	5.2	
Santiago de Cuba	82	26	31	29.85	29.93	......	82.6	......	94	1	91	72	7	74	22	75	72	78	2.71	......	13	2,531	ne.	17	ne.	1	9	19	3	4.8	
Santo Domingo	57	37	44	29.92	29.98	......	79.9	......	91	30	87	70	25	73	19	76	74	87	8.23	......	23	4,205	n.	34	e.	23	8	18	5	4.9	
Willemstad	75	39	46	29.80	29.87	......	82.4	......	90	24	87	73	5	78	15	76	74	80	1.55	......	9	8,506	e.	24	e.	10	6	22	3	5.2	

NOTE.—The data at stations having no departures are not used in computing the district averages. *More than one date.

TABLE II.—*Climatological record of voluntary and other cooperating observers, August,* 1901.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Alabama.					
Ashville	96	57	76.3	11.45	
Benton	.....	.....	.....	7.50	
Bermuda	97	63	80.2	7.69	
Birmingham	96	65	78.9	13.83	
Bridgeport	.....	.....	.....	13.32	
Burkville	.....	.....	.....	5.40	
Calera	.....	.....	.....	6.66	
Camp Hill	97	58	78.6	6.28	
Citronelle	96	64	80.1	15.91	
Clanton	90	60	77.2	5.18	
Cordova	100	58	79.0	12.20	
Daphne	96[e]	65[b]	80.2[f]	16.75	
Decatur	104	60	77.7	10.33	
Demopolis	.....	.....	.....	7.86	
Eufaula *a*	96	65	79.9	10.07	
Eutaw	98	65	80.5	5.04	
Evergreen	95	61	80.2	3.80	
Flomaton	95	62	79.6	.....	
Florence *a*	.....	.....	.....	8.04	
Fort Deposit	93	62	79.6	9.80	
Gadsden	101	58	79.4	10.44	
Goodwater	94	61	77.5	8.54	
Greensboro	97	62	79.6	5.63	
Greenville	.....	.....	.....	4.35	
Hamilton	98	.....	.....	6.52	
Healing Springs	98	63	80.1	10.07	
Helena	.....	.....	.....	6.55	
Highland Home	93	63	78.9	4.92	
Letohatchee	.....	.....	.....	4.32	
Livingston *a*	98	61	80.6	6.54	
Lock No. 4	99	60	78.4	8.64	
Madison	104	59	77.0	12.61	
Maplegrove	100	54	76.5	14.76	
Marion	98	66	80.6	4.85	
Mount Willing	96	64	80.8	7.75	
Newbern	95	67	81.1	5.31	
Newburg	102	58	77.5	12.68	
Notasulga	.....	.....	.....	8.81	
Oneonto	93	57	75.1	10.45	
Opelika	91	65	79.0	5.82	
Oxanna	93	58	77.2	7.37	
Prattville	92	60	78.1	.....	
Pushmataha	94	64	78.6	11.99	
Riverton	103	57	77.0	10.55	
Scottsboro	98	54	75.6	8.77	
Selma	96	65	79.8	6.44	
Talladega	97	60	77.0	6.97	
Tallassee	.....	.....	.....	4.65	
Thomasville	98	65	80.6	9.23	
Tuscaloosa	100	62	79.4	6.94	
Tuscumbia	102	61	77.8	10.08	
Tuskegee	97	66	80.0	6.70	
Union Springs	96	67	80.2	6.88	
Uniontown	97	64	80.0	5.53	
Valleyhead	98	59	76.2	13.80	
Verbena	.....	.....	.....	7.43	
Wetumpka	99	64	81.6	3.68	
Alaska.					
Juneau	67	45	53.8	14.04	
Kenai	73	31	52.6	4.85	
Killisnoo	66	40	51.5	5.95	
Sitka	63	39	53.8	10.03	
Arizona.					
Allaire Ranch	.....	.....	.....	1.93	
Arizona Canal Co. Dam	107	68	89.8	2.38	
Aztec *[5]	109	83	97.3	0.00	
Benson *[1]	98	62	82.7	0.76	
Bisbee	91	60	74.4	2.97	
Bowie *[1]	102	72	81.7	2.00	
Buckeye	110	60	89.4	0.80	
Casagrande *[1]	111	79	91.3	1.45	
Champie Camp	113	64	87.0	1.70	
Cochise *[1]	93	73	82.8	2.04	
Congress	104	64	86.0	1.39	
Dragoon *[1]	97	67	77.4	3.06	
Dudleyville	108	62	84.8	2.62	
Duncan	100	52	78.3	0.80	
Fort Apache	96	46	72.0	1.45	
Fort Defiance	94	46	70.3	0.99	
Fort Grant	98	60	78.7	1.32	
Fort Huachuca	94	58	75.0	4.79	
Fort Mohave [j]	119	61	94.8	0.01	
Gilabend *[1]	110	80	93.1	0.00	
Ingleside	111	51	84.7	2.04	
Jerome	98	62	81.0	2.20	
Kingman	104	59	83.0	1.81	
Maricopa *[1]	113	75	94.5	0.39	
Mesa	106	63	86.4	3.21	
Mohawk Summit *[1]	118	83	97.7	0.43	
Mount Huachuca	92	58	74.7	3.36	
Natural Bridge	.....	.....	.....	1.36	
Nogales	98	47	77.6	7.97	
Oracle	96	63	79.0	0.99	
Oro	.....	.....	.....	1.00	
Parker	118	64	93.2	0.30	
Phoenix	111	63	88.4	1.74	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Arizona—Cont'd.					
Pima	104	58	83.7	0.17	
Pinal Ranch	.....	.....	.....	1.52	
Prescott	95	46	72.6	1.59	
San Carlos	109	60	86.6	1.46	
Sentinel *[1]	117	82	95.1	0.00	
Showlow	.....	.....	.....	1.75	
Signal	116	59	89.8	0.74	
Silverking	.....	.....	.....	1.09	
Strawberry	93	46	71.2	2.88	
Supai	111	64	84.6	1.35	
Superstition	.....	.....	.....	2.65	
Taylor	94	44	70.4	2.08	
Tombstone	94	59	76.8	5.18	
Tonto	105[d]	60[d]	84.4[d]	0.83	
Truxton	100	60	79.8	2.37	
Tuba	100	59	80.0	0.09	
Tucson	106	63	84.8	1.99	
Vail *[5]	100	70	84.4	0.64	
Walnut Grove	.....	.....	.....	2.48	
Willcox *[1]	96	65	78.1	2.29	
Yarnell	.....	.....	.....	2.14	
Arkansas.					
Amity	100	59	80.8	2.27	
Arkadelphia	100	52	79.9	2.93	
Arkansas City	.....	.....	.....	3.87	
Batesville	107	59	82.3	0.90	
Beebranch	105	60	81.2	2.35	
Blanchard	99	61	80.8	4.87	
Brinkley	107	57	81.0	2.92	
Camden *a*	.....	.....	.....	2.54	
Camden *b*	96	65	82.4	0.82	
Conway	105	62	83.4	2.21	
Corning	106	55	79.2	1.87	
Dallas	98	61	80.0	3.33	
Dardanelle	.....	.....	.....	2.00	
Dutton	92[c]	56[c]	75.9[c]	3.02	
Elon	99	61	80.7	3.06	
Fayetteville	98	55	77.8	3.95	
Forrest City	107	59	81.1	3.80	
Fulton	.....	.....	.....	4.99	
Hardy	105	61	80.4	1.72	
Helena *a*	.....	.....	.....	9.14	
Helena *b*	104	63	80.0	8.53	
Hot Springs *b*	.....	.....	.....	1.22	
Ione	99	57	79.0	1.27	
Jonesboro	109	60	83.6	3.20	
Keesees Ferry	103	57	80.7	2.44	
Lacrosse [h]	104	60	80.8	0.45	
Lonoke	104	58	81.6	1.87	
Lutherville	98	58	79.0	4.21	
Malvern	103	62	82.1	3.70	
Marianna	106	58	80.1	5.73	
Marvell	108	59	80.8	4.98	
Mossville	96	58	77.6	2.62	
Mount Nebo	90	64	78.8	2.40	
New Gascony	100	60	82.6	2.86	
Newport *a*	.....	.....	.....	1.85	
Newport *b*	109	59	81.7	1.77	
Newport *c*	106	56	80.8	1.67	
Oregon	104	55	80.0	1.24	
Osceola	102	57	78.5	4.13	
Ozark	101	65	82.8	3.42	
Pinebluff	103	62	82.6	2.82	
Pocahontas	107	56	79.8	3.15	
Pond	101	52	78.2	2.98	
Prescott	100	62	82.6	2.66	
Rosadale	104	62	83.4	2.73	
Russellville	99	62	81.4	2.94	
Silversprings	101	56	79.2	2.26	
Spielerville	100	60	82.0	1.80	
Stuttgart	107	58	82.2	3.46	
Texarkana	103	61	83.0	2.22	
Warren	100	61	80.5	5.30	
Washington	98	62	80.4	3.68	
Wiggs	99	59	79.8	4.02	
Winslow	90	56	75.9	5.41	
Witts Springs [1]	98	61	79.4	1.96	
California.					
Angiola	112	48	80.6	0.00	
Bakersfield	112	53	82.6	0.00	
Ballast Point L. H.	.....	.....	.....	0.00	
Bear Valley	.....	.....	.....	0.00	
Berkeley	80	52	60.8	0.00	
Bishop	99	44	72.9	0.93	
Boca *[1]	79	40	60.9	0.08	
Bodie	82	24	55.2	1.62	
Bowman	94	48	69.6	0.05	
Branscomb	.....	.....	.....	T	
Campbell	93	44	65.8	0.02	
Cape Mendocino L. H.	.....	.....	.....	0.20	
Cedarville	94	45	70.4	0.88	
Chico *[1]	114	59	79.4	0.00	
Cisco *[1]	83	38	52.1	0.00	
Claremont	103	47	73.5	0.00	
Corning *[5]	106	62	81.2	0.00	
Crescent City	66	40	54.0	0.23	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
California—Cont'd.					
Crescent City L. H.	.....	.....	.....	0.21	
Cuyamaca *[5]	87	47	67.2	0.09	
Delano *[1]	113	64	83.0	0.00	
Delta *[1]	105	62	78.2	0.00	
Dunnigan *[1]	112	57	85.2	0.00	
Durham *[5]	105	54	79.3	0.00	
East Brother L. H.	.....	.....	.....	0.00	
Edmanton *[1]	94	47	66.4	0.50	
Elcajon	.....	.....	.....	0.00	
Elmdale	110	48	77.7	T.	
Elsinore	110	48	79.6	0.74	
Escondido	106	43	76.2	0.04	
Fallbrook	105	44	74.5	0.08	
Folsom City *[1]	106	58	76.4	0.11	
Fordyce Dam	.....	.....	.....	0.60	
Fort Ross	79	47	60.6	0.00	
Georgetown	102	50	76.2	T.	
Goshen	.....	.....	.....	0.00	
Greenville	99	32	65.8	0.00	
Hanford	109	49	79.2	T.	
Healdsburg	100	38	65.2	0.00	
Hollister	93	42	64.8	T.	
Humboldt L. H.	.....	.....	.....	0.50	
Idylwild	88	44	67.4	3.44	
Indio *[1]	115	80	94.0	0.00	
Iowa Hill *[1]	94	59	74.3	0.07	
Irvine	100	60	80.3	T.	
Jackson	98	43	73.8	T.	
Jolon	.....	.....	.....	0.00	
Kennedy Gold Mine	100	44	72.8	T.	
King City	.....	.....	.....	0.00	
Kono Tayee	97	54	76.6	T.	
Laguna Valley	.....	.....	.....	1.25	
Lamesa	.....	.....	.....	0.00	
Laporte *[1]	90	45	61.9	0.05	
Legrand	112	40	75.4	0.00	
Lemoncove	110	52	82.6	0.00	
Lemoore *[1]	105	57	80.0	0.00	
Lime Point L. H.	.....	.....	.....	0.00	
Lodi	103	48	73.6	T.	
Los Gatos *b*	95	45	67.4	T.	
Mammoth *[1]	114	80	96.6	2.50	
Manzana	103	55	82.6	0.65	
Mare Island L. H.	.....	.....	.....	0.00	
Merced *b*	111	52	80.8	0.00	
Mills College	.....	.....	.....	T.	
Milo	.....	.....	.....	0.00	
Milton (near)	106	50	76.8	T.	
Modesto *[1]	107	53	79.1	0.00	
Mohave *[1]	105	65	81.0	1.75	
Mokelumne Hill *[3]	.....	50	72.8	T.	
Monterio	104	54	79.4	1.12	
Monterey *[5]	88	51	66.2	0.00	
Morena	110	45	76.2	0.20	
Mount St. Helena	.....	.....	.....	0.00	
Napa *b*	94	42	65.3	0.00	
Needles	112	74	93.2	0.50	
Nevada City	92	45	68.8	T.	
Newhall *[1]	109	60	76.2	0.00	
Niles *[1]	100	56	68.9	0.03	
North Bloomfield	102	46	74.0	T.	
North Ontario	98	52	74.9	0.00	
North San Juan *[1]	101	50	73.7	T.	
Oakland *a*	84	52	62.0	T.	
Ogilby *[5]	116	80	99.7	0.00	
Oleta *[1]	101	50	72.2	T.	
Orland *[1]	116	58	86.8	0.00	
Palermo	112	48	77.4	0.00	
Palomar Mountain	.....	.....	.....	0.50	
Paso Robles	109	40	72.3	0.00	
Peachland *[5]	90	51	65.6	T.	
Piedras Blancas L. H.	.....	.....	.....	0.00	
Pigeon Point L. H.	.....	.....	.....	0.00	
Pilot Creek	.....	.....	.....	T.	
Pine Crest	97	53	70.6	0.03	
Placerville	99	44	71.2	0.00	
Point Ano Nuevo L. H.	.....	.....	.....	0.00	
Point Arena L. H.	.....	.....	.....	0.00	
Point Bonita L. H.	.....	.....	.....	0.28	
Point Conception L. H.	.....	.....	.....	0.00	
Point Fermin L. H.	.....	.....	.....	0.10	
Point George L. H.	.....	.....	.....	0.24	
Point Hueneme L. H.	.....	.....	.....	0.30	
Point Lobos	67	50	55.8	0.00	
Point Loma L. H.	.....	.....	.....	0.00	
Point Montara L. H.	.....	.....	.....	0.00	
Point Pinos L. H.	.....	.....	.....	0.00	
Point Sur L. H.	.....	.....	.....	0.00	
Pomona (near)	109	49	78.0	0.00	
Poway *[5]	99	56	74.6	0.02	
Quincy	94	35	66.4	T.	
Ranch House	90	56	74.2	0.07	
Redding	107	54	81.4	T.	
Redlands	106	52	79.2	0.00	
Reedley	110	52	84.4	0.00	
Represa	100	50	74.8	0.03	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
California—Cont'd.					
Roe Island L. H.	......	......	......	0.00	
Rohnerville	72	50	57.8	0.06	
Rosewood	117	47	80.0	T.	
Sacramento	101	50	72.1	0.02	
Salinas*[1]	80	50	60.2	0.00	
Salton*[5]	124	75	101.0		
San Bernardino	110	42	78.4	0.27	
San Jacinto	108	50	80.0	1.53	
San Jose	......	......	......	T	
San Leandro	85	50	62.3	0.02	
San Luis L. H	......	......	......	0.00	
San Mateo[1]*	88	59	68.2	0.00	
San Miguel*[1]	105	53	73.8	0.00	
San Miguel Island	73	37	58.6	0.00	
Santa Barbara	86	54	67.2	0.09	
Santa Barbara L. H	......	......	......	0.00	
Santa Clara	......	......	......	T.	
Santa Cruz	85	41	61.6	0.00	
Santa Cruz L. H	......	......	......	0.00	
Santa Maria	82	46	64.9	0.00	
Santa Monica	84	48	64.6	0.00	
Santa Paula	97	50	71.6	0.00	
Santa Rosa*[1]	92	47	62.0	0.00	
Shasta	115	52	83.2	0.00	
Sierra Madre	100	52	73.9	0.00	
Sonoma	......	......	......	0.00	
S. E. Farallone L. H	......	......	......	0.00	
Stanford University	87	46	64.5	0.00	
Stockton	97	48	71.0	0.00	
Summerdale	90	47	68.2	T.	
Susanville	98	44	70.8	1.77	
Tehama*[1]	110	61	84.0	0.00	
Tejon Ranch	105	56	83.3	T.	
Templeton*[1]	110	55	74.1	0.00	
Trinidad L. H.	......	......	......	0.00	
Truckee*[1]	90	40	57.3	0.00	
Tulare *b*	......	......	......	0.00	
Tulare *c*	110	50	81.1	T.	
Ukiah	108	41	72.6	0.00	
Upperlake	106	44	75.2	T.	
Upper Mattole[1]*	94	44	64.3	0.17	
Vacaville*[1]	107	55	74.1	0.00	
Ventura	76	49	64.6	0.09	
Visalia *b*	110	50	80.9	0.00	
Volcano Springs[1]*	121	78	99.9	0.28	
Wasco	111	55	83.3	0.00	
West Saticoy	......	......	......	0.00	
Wheatland	105	51	75.8	T.	
Williams*[5]	108	57	82.8	0.00	
Wilmington*[1]	82	50	64.2	0.00	
Wire Bridge*[5]	106	55	79.6	T.	
Yerba Buena L. H	......	......	......	0.00	
Yreka	102	40	72.2	0.95	
Yuba City*[5]	106	67	82.4	T.	
Zenia	......	......	......	0.10	
Colorado.					
Alford	101	42	66.0	1.73	
Amity	99	55	75.2	1.89	
Arkins	......	......	......	1.12	
Ashcroft	......	......	......	3.05	
Bailey	86	37	60.6	3.14	
Blaine	102	56	77.3	2.05	
Boulder	95	54	71.3	1.69	
Boxelder	......	......	......	1.66	
Breckenridge	82	30	53.4	4.94	
Buenavista	......	......	......	0.48	
Canyon	95	50	73.4	1.37	
Castlerock	93	45	68.4	3.45	
Cedaredge	99	47	70.7	1.42	
Cheyenne Wells	97	54	74.0	2.76	
Clearview	76	38	56.5	3.16	
Collbran	97	45	69.7	2.08	
Colorado Springs	87	48	67.6	2.24	
Delta	105	46	75.0	1.21	
Durango	96	45	69.8	2.05	
Fort Collins	97	45	69.1	0.57	
Fort Morgan	97	51	73.2	0.96	
Fox	......	......	......	4.62	
Gilman	......	......	......	2.63	
Gleneyrie	83	50	66.4	2.14	
Glenwood Springs	......	......	......	2.00	
Greeley	98	49	72.4	0.47	
Grover	......	......	......	1.08	
Gunnison	89	33	62.1	1.39	
Hamps	92	47	68.8	2.58	
Hoehne (near)	96	50	72.1	0.93	
Holly	101	58	77.4	1.91	
Holyoke (near)	99	48	74.0	2.29	
Hugo	......	......	......	2.54	
Husted	92	45	66.7	3.59	
Lake Moraine	75	36	53.6	5.40	
Lamar	103	56	78.4	4.01	
Laporte	......	......	......	0.87	
Las Animas	100	54	75.7	1.23	
Lay	96	36	66.2	0.94	
Leadville (near)	......	......	......	1.69	
Colorado—Cont'd.					
Leroy (near)	96	51	72.5	4.03	
Longs Peak	80	37	55.8	2.22	
Mancos	95	41	67.3	2.47	
Marshall Pass	......	......	......	0.36	
Meeker	94	39	64.8	2.05	
Montrose	......	......	......	2.31	
Moraine	90	38	60.0	2.65	
Pagoda	97	36	65.1	2.56	
Parachute	104	41	74.9	1.52	
Perrypark	......	......	......	1.90	
Rangely	98	42	67.9	1.87	
Rockyford	100	53	75.2	0.74	
Rogers Mesa	100	48	73.2	1.87	
Ruby	......	......	......	1.47	
Russell	84	35	60.4	0.96	
Saguache	91	42	65.4	1.82	
Salida	95	42	67.4	2.01	
San Luis	89	40	64.4	3.21	
Santa Clara	88	42	64.2	1.79	
Sapinero	......	......	......	1.27	
Seibert	......	......	......	4.09	
Silt	99	42	70.2	2.10	
Sugarloaf	88	46	65.0	4.90	
Telluride	87	36	60.4	3.77	
Trinidad	94	52	71.2	2.63	
T. S. Ranch	92	52	72.2	2.15	
Twinlakes	......	......	......	1.69	
Vilas	......	......	......	2.97	
Wagon Wheel	86	30	57.2	2.85	
Walden	93	35	59.6	2.44	
Wallet	......	......	......	2.42	
Westcliffe (near)	86	39	61.0	1.90	
Whitepine	......	......	......	2.51	
Wray	98	52	73.8	5.36	
Yuma	......	......	......	6.53	
Connecticut.					
Bridgeport	89	55	72.6	8.66	
Canton	84	50	68.7	6.42	
Colchester	88	53	70.4	7.83	
Falls Village	......	......	......	9.04	
Hartford *b*	84	57	71.2	7.13	
Hawleyville	87	50	70.3	7.81	
Lake Konomoc	......	......	......	3.85	
Middletown	87	52	70.6	7.78	
New London	88	58	72.0	1.35	
North Grosvenor Dale	87	50	70.6	5.01	
Norwalk	92	51	72.8	8.97	
Southington	83	53	69.9	5.95	
South Manchester	......	......	......	9.53	
Storrs	83	54	68.8	7.58	
Voluntown	88	47	69.8	3.33	
Waterbury	89	51	73.0	9.37	
West Cornwall	84	53	69.0	6.97	
West Simsbury	......	......	......	5.82	
Delaware.					
Milford	95	58	77.7	5.30	
Millsboro	94	57	76.8	7.81	
Newark	88	58	74.6	9.78	
Seaford	92	59	77.6	5.29	
Wyoming	......	......	......	7.48	
District of Columbia.					
Distributing Reservoir*[5]	87	65	76.6	3.85	
Receiving Reservoir*[5]	87	65	76.5	3.70	
West Washington	93	58	76.4	4.67	
Florida.					
Archer	94	65	80.0	10.01	
Bartow	91	71	80.8	12.39	
Brooksville	95	68	79.8	16.34	
Carrabelle	90	69	79.5	8.49	
Clermont	95	68	81.4	7.78	
De Funiak Springs	96	64	79.0	13.22	
Deland	95	68	80.4	......	
Earnestville	95	68	81.4	19.75	
Eustis	98	69	82.0	13.00	
Federal Point	92	68	79.6	9.62	
Flamingo	96	70	81.9	12.65	
Fort Meade	97	67	80.8	19.60	
Fort Pierce	90	68	79.6	9.43	
Gainesville	92	66	80.0	9.54	
Huntington	95	67	81.4	10.75	
Hypoluxo	93	70	81.2	10.07	
Inverness	94	68	79.9	14.32	
Kissimmee	95	68	80.8	9.91	
Lake Butler	95	65	80.2	9.57	
Lake City	95	67	80.7	8.72	
Macclenny	97	66	81.2	10.96	
Manatee	94	68	80.7	12.91	
Marco	98	68	82.9	9.34	
Marianna	90	64	78.8	8.43	
Merritt Island	90	72	80.8	4.71	
Miami	90	70	81.2	10.85	
Micanopy	93	64	80.2	13.74	
Middleburg	99	64	80.0	10.18	
Myers	90	70	79.0	12.41	
New Smyrna	93	66	79.1	6.35	
Nocatee	96	69	81.2	12.53	
Florida—Cont'd.					
Ocala	96	66	81.0	13.46	
Orange City	95	68	80.9	12.87	
Orlando	92	70	80.5	13.18	
Plant City	96	67	81.0	12.05	
Rockwell	97	68[f]	81.6[e]	13.40	
St. Andrews	96	66	80.1	8.75	
St. Augustine	91	72	82.2	4.01	
Sebastian	90	71	79.8	5.22	
Stephensville*[1]	96	70	77.9	12.64	
Sumner	94	66	79.6	15.97	
Switzerland	95	66	80.1	6.57	
Tallahassee	89	67	78.5	13.40	
Tarpon Springs	93[g]	68[g]	80.9[g]	8.85[f]	
Titusville	92	68	79.5	6.30	
Wausau	96	65	79.8	10.10	
Wewahitchka	94	65	79.4	9.72	
Georgia.					
Adairsville	91	59	76.4	10.98	
Albany	101	67	81.2	8.73	
Allapaha	98	64	79.7	9.80	
Allentown	98	61	80.1	9.63	
Americus	95	63	79.8	7.86	
Athens *b*	95	63	76.2	17.87	
Auburn	95	62[k]	76.8[d]	10.82	
Bainbridge	97	65	79.2	7.31	
Blakely	92	......	......	9.55	
Bowersville	94	64	76.6	17.14	
Brent	96	65	78.8	8.12	
Camak	96	66	79.9	3.22	
Canton	......	......	......	9.21	
Carlton	......	......	......	12.23	
Clayton	89	55	73.5	22.07	
Columbus	96	68	81.8[e]	7.14	
Covington	96	64	77.9	10.75	
Dahlonega	90	60	74.0	12.74	
Diamond	89	55	72.0	17.60	
Dublin	......	......	......	5.99	
Eastman	98	65	81.4	5.08	
Elberton	90	66	77.6	15.41	
Experiment	95	63	77.0	6.27	
Fitzgerald	96	62	80.4	5.93	
Fleming	95	64	79.7	6.76	
Fort Gaines	96	65	80.4	8.87	
Gainesville	92	65	75.3	13.58	
Gillsville	95	62	76.0	11.73	
Greenbush	94	56	76.0	12.31	
Griffin	97	65	78.4	7.64	
Harrison	94	64	78.9	6.19	
Hawkinsville	92	65	79.4	8.89	
Hephzibah	94	65	80.0	9.20	
Jesup	92	63	79.4	7.24	
Lost Mountain	91	64	76.2	9.06	
Lumpkin	98	62	79.7	7.79	
Marshallville	93[j]	67[j]	81.4[j]	6.68	
Mauzy	96	65	80.0	8.52	
Milledgeville	89	65	77.6	8.45	
Millen	98	66	81.6	5.67	
Morgan	93	62	77.9	11.16	
Naylor	96	65	80.0	9.85	
Newnan	96	64	77.0	8.15	
Oakdale	......	......	......	9.67	
Point Peter	97	62	77.4	15.67	
Poulan	93	63	78.6	14.73	
Putnam	......	......	......	3.38	
Quitman	95	64	79.1	8.73	
Ramsey	91	55	74.5	15.02	
Resaca	......	......	......	11.55	
Rome	96	58	77.0	12.38	
Statesboro	95	65	80.1	10.65	
Talbotton	96	63	78.1	7.36	
Thomasville	93	66	79.2	11.59	
Toccoa	89	61	75.0	20.66	
Union Point	93	67	77.8	7.02	
Vidalia	95	65	80.3	7.97	
Washington	92	66	78.6	8.89	
Waverly	95	66	80.4	13.37	
Waycross	96	67	79.6	8.18	
Waynesboro	93	67	79.2	6.01	
Westpoint	96	66	79.6	10.23	
Woodbury	96	61	77.9	9.15	
Idaho.					
Albion	101	48	77.5	0.02	
American Falls	99	42	71.1	T.	
Atlanta	93	34	63.7	0.17	
Blackfoot	96	40	71.8	0.60	
Burnside	90	42	68.2	0.82	
Chesterfield	90	30	61.8	1.68	
Downey	98	39	68.2	0.18	
Forney	93	32	62.8	0.29	
Garnet	108	51	81.6	0.00	
Hailey	98	39	69.4	0.18	
Idaho City	100	40	68.8	0.01	
Kootenai	......	......	......	0.21	
Lake	82	36	60.4	1.45	
Lakeview	94	47	68.1	0.13	
Lost River	93	36	67.2	0.37	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Idaho—Cont'd.	°	°	°	Ins.	Ins.
Moscow	99	43	69.6	0.17	
Murray	94	41	65.3	0.62	
Oakley	100	41	70.5	1.20	
Ola	104	44	75.4	0.11	
Payette	106	44	78.2	0.12	
Pollock	103	45	71.6	0.64	
Priest River	95	42	66.7	0.31	
St. Maries	97	40	68.0	0.32	
Soldier	99	32	67.2	0.09	
Swan Valley	93	29	65.8	2.29	
Vernon	94	38	67.0	1.36	
Weston	93	37	69.7	2.00	
Illinois.					
Albion	99	58	76.6	2.11	
Aledo	94	52	74.0	0.44	
Alexander	102	53	75.6	2.84	
Antioch	91	49	69.4	1.31	
Ashton	98	50	70.3	0.44	
Astoria	94	50	71.7	0.70	
Aurora *a*	95	52	72.2	1.06	
Bloomington	99	51	75.2	1.07	
Bushnell	99	52	76.2	1.20	
Cambridge	98	51	73.2	1.38	
Carlinville	106	52	77.6	1.83	
Centralia	108	50	79.1	3.52	
Chemung	94	43	69.0	2.28	
Chester	......	......	......	2.32	
Cisne	106	54	77.9	2.61	
Coatsburg	98	53	77.2	0.32	
Cobden	104	59	78.0	5.96	
Danville	102	52	75.2	2.05	
Decatur	103	51	75.8	0.86	
Dixon	94	52	73.7	0.53	
Dwight	93	50	73.0	1.67	
Effingham	104	50	76.4	1.09	
Equality	100	53	76.8	3.39	
Flora	101	55	75.4	2.80	
Galva	93	47	72.6	1.38	
Grafton	......	......	......	1.08	
Grayville	98	60	76.6	1.39	
Greenville	104	56	78.0	4.40	
Griggsville	99	55	77.4	0.22	
Halfway	100	59	77.4	3.60	
Halliday	103	51	77.6	2.51	
Havana[3]	98	53	75.2	1.04	
Henry	96	51	73.5	1.90	
Hillsboro	104	55	77.4	4.26	
Joliet	91	52	71.2	2.84	
Kishwaukee	95	46	70.6	1.36	
Knoxville	91	47	72.2	0.65	
Lagrange	93	49	70.8	2.00	
Laharpe	98	51	75.4	0.50	
Lanark	96	41	71.8	0.27	
La Salle	91	54	72.9	2.80	
Loami	......	......	......	1.69	
McLeansboro	101	59	77.0	2.65	
Martinton	97	45	73.2	3.15	
Mascoutah	104	52	76.0	0.73	
Mattoon	95	53	73.6	1.07	
Melrose	104	52	76.0	1.56	
Minonk	95	50	72.8	0.75	
Monmouth	96	47	73.6	0.37	
Monticello	102	49	74.8	1.99	
Morgan Park	......	......	......	1.24	
Morrison	91	48	70.9	0.29	
Morrisonville	104	53	77.1	1.13	
Mount Carmel	......	......	......	1.46	
Mount Pulaski	99	52	77.0	1.17	
Mount Vernon	107	52	77.0	3.29	
New Burnside	101	57	78.0	2.81	
Olney	102	56	77.3	3.45	
Ottawa	97	54	74.7	0.81	
Palestine	98	46	77.8	2.75	
Pana	104	52	76.2	2.66	
Paris	101	55	76.1	2.53	
Peoria *a*	......	......	......	1.50	
Peoria *b*	96	53	75.0	1.29	
Philo	101	48	74.0	2.44	
Plumhill	106	52	77.4	2.48	
Rantoul	102	53	74.2	4.37	
Raum	97	60	78.0	3.54	
Riley	93	53	71.4	1.15	
Robinson	102	56	76.6	2.06	
Rockford	94	54	73.0	1.16	
St. Charles	92	52	72.8	1.01	
St. John	103	51	77.4	2.46	
Scales Mound	94	48	72.8	0.59	
Shobonier	106	52	77.5	1.61	
Strawn	96	50	72.8	3.00	
Streator	94	51	72.8	2.56	
Sullivan	103	56	76.1	3.25	
Sycamore	91	49	70.7	1.06	
Tilden	107	54	74.8	1.05	
Tiskilwa	90	49	71.8	2.02	
Tuscola	104	50	76.2	2.70	
Walnut	93	50	73.4	1.58	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Illinois—Cont'd.	°	°	°	Ins.	Ins.
Wellington	98	50	73.5	3.56	
Winchester	101	54	77.2	0.47	
Winnebago	95	50	71.8	1.21	
Yorkville	93	48	71.0	0.80	
Zion	94	50	72.1	0.05	
Indiana.					
Anderson	95	52	74.5	1.60	
Angola	93	51	71.5	4.58	
Auburn	97	47	71.6	3.71	
Bedford	99	50	77.0	2.05	
Bloomington	95	50	75.2	2.63	
Bluffton	97	46	73.8	4.79	
Butlerville	99	54	75.8	2.78	
Cambridge City	95	52	73.2	4.65	
Columbus	101	56	76.6	3.07	
Connersville	98	55	74.7	2.47	
Crawfordsville	100[c]	55[c]	77.2[c]	5.70	
Delphi	100	49	74.2	2.81	
Edwardsville*[1]	92	63	76.7	1.85	
Farmland	94	49	72.2	4.39	
Greencastle	95	56	75.0	3.16	
Hammond	94	50	70.8	1.34	
Hector	96	49	72.6	2.72	
Huntington	95	......	......	2.53	
Jeffersonville	96	61	76.8	3.32	
Knightstown	97	55	74.7	3.31	
Kokomo	95	51	74.3	3.35	
Lafayette	101	52	75.5	2.50	
Laporte	99	48	73.2	3.71	
Logansport	9[illegible]	50	74.4	3.38	
Madison *a*	97	59	76.6	3.18	
Madison *b*	......	......	......	2.01	
Marengo	98	54	75.2	2.67	
Marion	101	48	75.2	2.77	
Markle	97	46	72.8	3.80	
Mauzy	96	53	74.3	4.47	
Mount Vernon	98	57	77.7	2.39	
Northfield	97	48	73.2	4.52	
Paoli	100	54	77.0	2.07	
Prairie Creek	103	52	76.8	0.86	
Princeton	100	53	75.8	2.10	
Rensselaer	97	49	74.3	......	
Richmond	94	50	73.6	3.56	
Rockville	99	55	74.8	3.46	
Salem	101	52	76.8	2.84	
Scottsburg	98	58	77.6	1.84	
Seymour	94	60	76.0	7.77	
Shelbyville	96	59	76.4	2.89	
South Bend	96	47	73.0	2.46	
Syracuse	97	48	73.6	1.05	
Terre Haute	100	50	77.4	2.63	
Topeka	93	44	71.9	4.84	
Valparaiso	96	50	73.2	1.06	
Veedersburg	101	50	76.5	4.40	
Vevay	97	56	76.8	1.55	
Vincennes	102	57	78.0	3.90	
Washington	99	53	76.6	3.67	
Winamac	98	......	......	3.29	
Worthington	97	55	75.6	2.26	
Indian Territory.					
Ardmore	110	64	84.2	2.72	
Bengal	102	58	79.5	3.07	
Chickasha	108	60	83.0	0.77	
Claremore	109	60	84.0	0.90	
Fairland	101	58	79.6	3.89	
Hartshorne	105	60	82.3	2.39	
Healdton	110	57	82.3	2.95	
Holdenville	104	59	81.2	0.18	
Lehigh	102	65	82.4	2.95	
Marlow	108	62	83.1	0.57	
Muscogee	100	61	81.5	1.48	
Pauls Valley	108	57	82.6	0.70	
Roff	102	65	82.7	2.87	
Ryan	108	65	85.5	0.88	
Sapulpa	102	58	82.4	1.55	
South McAlester	......	......	......	2.58	
Tahlequah	104	57	80.8	1.82	
Tulsa	......	......	......	0.78	
Wagoner	107[b]	57[i]	83.7[i]	1.95	
Webbers Falls	106	54	83.5	1.06	
Iowa.					
Afton	97	50	73.6	0.44	
Albia	94	51	73.6	1.25	
Algona	92	48	72.6	3.61	
Alta	98	51	72.9	3.70	
Amana	93	50	72.8	0.98	
Ames *b*	97	48	72.8	1.21	
Atlantic	101	47	74.7	1.13	
Battle Creek	......	......	......	3.17	
Baxter	94	49	73.4	0.87	
Belknap	96	55	75.8	0.33	
Belleplaine	92	51	72.8	1.27	
Bonaparte	98	53	77.2	0.31	
Britt	92	46	70.2	1.94	
Buckingham	......	......	......	1.06	
Burlington	94	54	76.4	0.36	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	Ins.	Ins.
Bussey	......	......	......	0.95	
Carroll	97	50	74.0	2.24	
Cedar Rapids	94	48	74.2	0.42	
Centerville	95	53	76.0	0.21	
Chariton	96	51	74.3	0.61	
Charles City	98	48	72.4	2.08	
Clarinda	100	52	76.1	0.65	
Clearlake	100	49	74.7	1.45	
Clinton	93	48	73.4	0.48	
College Springs	97	55	75.6	0.74	
Columbus Junction	97	51	75.0	1.75	
Corning	95	49	74.0	0.70	
Council Bluffs	102	55	77.1	0.88	
Cresco	93	44	71.2	1.36	
Cumberland	......	......	......	0.71	
Danville	......	......	......	T.	
Decorah	96	44	71.6	1.02	
Delaware	95	46	72.5	0.62	
Denison	101	48	74.5	0.65	
Desoto	96	55	75.1	0.72	
Dows	94	48	70.8	2.22	
Eldon	96	50	75.9	0.60	
Elkader	98	48	74.4	0.82	
Emerson	......	......	......	T.	
Estherville	94	41	70.4	4.28	
Fayette	94	44	72.0	3.04	
Fonda	......	......	......	1.02	
Forest City	93	40	71.4	2.15	
Fort Dodge	97	47	71.6	1.33	
Fort Madison	......	......	......	0.05	
Galva	100	47	73.8	1.45	
Gilman	......	......	......	0.86	
Glenwood	103	52	76.5	0.98	
Grand Meadow	94	48	72.5	0.99	
Greene	98	48	73.6	2.17	
Greenfield	97	53	75.2	1.17	
Grinnell (near)	92	54	74.1	1.27	
Grundy Center	93	49	72.4	1.86	
Guthrie Center	95	50	73.8	1.25	
Hampton	99	50	74.6	1.84	
Harlan	98	50	73.9	0.81	
Hawkeye	......	......	......	1.47	
Hopeville	97	54	75.3	0.55	
Hoprig	......	......	......	2.78	
Humboldt	95	47	72.0	1.74	
Independence	94	47	72.6	1.37	
Indianola	96	53	75.8	0.57	
Iowa City	97	49	74.8	0.66	
Iowa Falls	92	47	70.8	1.83	
Jefferson	......	......	......	1.01	
Keosauqua	95	55	76.6	0.41	
Knoxville	94	53	74.9	0.50	
Lacona	......	......	......	0.70	
Larrabee	98	50	72.9	1.90	
Leclaire	......	......	......	0.54	
Lemars	98	48	72.9	1.09	
Lenox	94	54	75.1	0.90	
Logan	98	50	76.2	0.77	
Maple Valley	......	......	......	2.55	
Maquoketa	96	46	72.2	0.76	
Marshalltown	96	50	74.2	1.16	
Monticello	96	45	70.4	0.97	
Mooar	98	49	73.4	0.13	
Mountayr	99	53	75.8	0.75	
Mount Pleasant	92	47	72.2	0.48	
Mount Vernon *b*	98	52	76.7	0.80	
Murray	......	......	......	0.22	
New Hampton	93[b]	48[c]	72.0[c]	1.68	
Newton	93	52	73.8	1.30	
Northwood	93	46	71.9	1.83	
Odebolt	102	48	75.7	1.29	
Ogden	96	50	73.2	1.38	
Olin	92	47	70.9	0.64	
Onawa	100	55	75.0	2.24	
Osage	89	47	70.4	1.80	
Osceola	98	52	74.6	0.40	
Oskaloosa	96	53	74.5	0.81	
Ottumwa	94	58	75.8	1.36	
Ovid	98	52	76.3	0.91	
Pacific Junction	105	51	75.6	1.26	
Pella	98	50	74.6	......	
Perry	96	50	74.2	1.49	
Plover	98	45	71.1	2.90	
Primghar	100	50	76.2	2.05	
Redoak	93	59	76.2	1.07	
Ridgeway	92	50	73.7	1.51	
Rockwell City	95	50	73.0	0.55	
Ruthven	92[i]	53	75.2[e]	2.62	
Sac City	98	50	73.9	1.21	
St. Charles	95	54	75.2	0.33	
Scranton	95	51	73.6	1.84	
Sheldon	94	46	72.4	1.73	
Sibley	98	47	72.6	2.58	
Sigourney	100	49	75.8	0.48	
Sioux Center	96	52	72.3	4.46	
Spirit Lake	98	50[c]	74.4	2.46	

TABLE II.—*Climatological record of voluntary and other cooperating observers.*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Storm Lake	95	49	73.4	2.15	
Stuart	96	57	75.3	0.20	
Thurman	95	52	74.2	1.50	
Toledo	98	48	74.0	1.58	
Villisca	103	51	73.2	0.69	
Vinton *[1]	93	52	72.8	0.76	
Wapello [d]	96	55	75.9	0.18	
Washington	95	40	73.3	0.24	
Washta	......	......	......	2.04	
Waterloo	95	49	73.0	1.40	
Waverly	98	51	73.2	1.80	
Westbend	96	47	71.8	2.20	
West Union	......	......	......	0.73	
Wilton Junction	95	47	73.4	0.67	
Winterset	99	53	75.4	0.86	
Woodburn	......	......	......	0.53	
Kansas.					
Abilene	104	59	80.5	1.90	
Achilles	102[c]	50[c]	74.4[c]	5.12	
Altoona	......	......	......	2.82	
Anthony	......	......	......	0.93	
Atchison *a*	100	59	78.4	2.92	
Baker	101	59	77.6	2.50	
Beloit	103	64	80.6	2.74	
Burlington	107	56	80.2	2.18	
Chanute	107	59	81.5	3.00	
Colby	101	52	75.9	3.58	
Columbus	102	59	80.0	3.57	
Coolidge	106	42	77.2	2.54	
Delphos	106	57	80.6	3.07	
Dresden	102	55	76.3	3.63	
Ellinwood	107	57	79.2	2.82	
Emporia	100	60	79.4	2.02	
Englewood	106	61	81.0	2.78	
Eureka Ranch	104	53	78.2	3.66	
Fallriver	105[c]	54[c]	79.8[c]	3.62	
Farnsworth *[1]	104	59	77.3	2.01	
Fort Leavenworth	102	61	79.8	1.80	
Fort Scott	107	60	80.8	2.52	
Frankfort	109	52	76.6	1.76	
Garden City	104	57	80.4	2.03	
Gove *[1]	102	60	79.2	3.87	
Grenola	107	58	80.5	3.23	
Hanover	105	58	79.6	1.93	
Harrison	104	53	78.6	2.12	
Hays	108	54	79.8	5.67	
Horton	102	59	77.8	1.91	
Hoxie	102	54	76.8	4.72	
Hutchinson	107	55	79.8	2.42	
Independence	106	61	82.0	3.09	
Jetmore	106	49	78.6	3.03	
Lakin	102	57	77.4	2.59	
Lawrence	98	60	78.1	3.46	
Lebanon	100	53	76.9	1.60	
Lebo	103	58	79.6	2.20	
Leoti	101	52	76.4	2.75	
Little River	108	56	80.4	1.30	
Macksville	107	52	78.9	1.79	
McPherson	109	58	82.4	2.65	
Madison	105	55	78.4	2.45	
Manhattan *c*	105	56	79.6	2.65	
Marion	104	58	80.1	1.35	
Medicine Lodge	107	58	81.8	1.58	
Minneapolis	104	57	80.1	2.20	
Moran	107	57	81.6	4.04	
Mounthope *[1]	104	63	82.1	1.56	
Ness City	110	56	81.6	2.23	
Newton	105	53	79.0	1.71	
Norwich	105	56	81.2	0.71	
Oberlin	......	......	......	5.31	
Olathe	102	61	77.8	2.32	
Osborne	......	......	......	1.38	
Oswego	104	60	81.2	3.59	
Ottawa	107	54	78.0	2.67	
Phillipsburg	108	56	80.4	2.15	
Pratt	104	54	80.2	3.16	
Rome	107	58	80.2	0.88	
Salina	108	56	80.0	1.91	
Scott	102	50	75.7	3.56	
Sedan	101	60	79.4	4.52	
Seneca	103	53	75.9	3.14	
Toronto	107	54	80.0	1.49	
Tribune	100	54	75.2	1.95	
Ulysses	104[d]	58[d]	79.3[d]	1.95	
Valley Falls	103	59	76.8	3.46	
Viroqua	102	57	77.5	3.26	
Wakeeney (near)	......	......	......	4.28	
Wallace	......	......	......	4.75	
Wamego *[1]	103	62	77.8	1.77	
Winfield	103	59	81.0	1.24	
Kentucky.					
Alpha	98	55	74.8	15.50	
Anchorage	100	50	76.3	2.87	
Bardstown	98	56	77.0	3.59	
Berea	94	55	73.6	7.45	
Blandville	98	60	76.6	5.48	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Kentucky—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bowling Green	101	59	75.6	7.34	
Burnside	......	......	......	11.90	
Carrollton	98	60	77.8	1.61	
Catlettsburg	94	58	76.2	3.93	
Centertown	98	56	76.0	10.03	
Earlington	95	58	75.1	4.14	
Edmonton	99	52	75.4	7.31	
Eubank	93	52	72.6	6.86	
Falmouth	......	......	......	2.74	
Fords Ferry	97	54	75.3	2.00	
Frankfort	92	58	75.0	2.59	
Franklin	94	58	75.9	7.22	
Georgetown	91	60	74.4	......	
Greensburg	100	59	76.2	3.66	
Henderson	95	59	76.5	2.55	
Hopkinsville	100	58	76.8	4.99	
Irvington [l]	92	56	75.0	2.06	
Leitchfield	94	57	74.5	5.80	
Loretto	96	56[l]	74.6[f]	4.93	
Marrowbone	94	53	73.6	6.67	
Maysville	98	55	76.5	2.06	
Mount Sterling	94	56	73.8	6.44	
Owensboro	93	58	75.5	3.38	
Owenton	91	59	74.3	1.42	
Paducah *a*	......	......	......	7.14	
Paducah *b*	100	62	79.2	6.56	
Pikeville [h]	95	58	76.0	4.90	
Richmond	97	58	75.4	4.19	
St. John	92	55	74.2	3.86	
Scott	98	57	76.2	1.64	
Shelby City	94	51	72.9	3.90	
Shelbyville	98	55	76.0	2.88	
Warfield	93	59	74.2	4.76	
Williamsburg	94	59	74.6	10.58	
Louisiana.					
Abbeville	93	70	81.6	2.70	
Alexandria	102	64	83.6	3.55	
Amite	98	68	81.9	4.57	
Baton Rouge	96	68	81.8	3.81	
Burnside	96	68	81.2	4.54	
Calhoun	99	63	80.6	3.87	
Cheneyville	100	63	82.4	2.72	
Clinton	92	66	80.1	4.86	
Collinston [f]	99	65	81.8	4.11	
Covington	96	67	81.6	10.61	
Donaldsonville	95	69	81.2	6.65	
Emilie	95	69	80.6	6.14	
Farmerville	99	68	82.2	6.49	
Franklin	96	70	81.8	10.20	
Grand Coteau	96	67	81.7	4.70	
Hammond	98	68	82.2	3.42	
Houma	97	67	83.0	6.89	
Jeanerette	99	70	83.3	6.54	
Jennings	96	68	81.8	6.79	
Lafayette	98	68	81.8	4.06	
Lake Charles	96	70	83.0	4.81	
Lake Providence	97	67	81.0	8.37	
Lawrence	99	69	82.4	10.26	
Libertyhill	104	63	82.3	3.98	
Mansfield	103	63	81.5	2.46	
Melville	96	66	81.4	5.20	
Minden	105	62	83.4	1.86	
Monroe	98	68	83.0	6.27	
New Iberia	94[c]	70[c]	81.2[c]	4.50	
Opelousas	99[h]	63	81.8[d]	7.18	
Oxford	100	62	82.4	2.39	
Paincourtville	96	69	81.2	10.69	
Plain Dealing	101	60	81.0	4.23	
Prevost	......	......	......	3.03	
Rayne	98	67	83.2	6.06	
Reserve	99	68	81.0	2.98	
Robeline	102	52	79.9	3.50	
Ruddock	98	68	82.0	5.02	
Ruston	97	65	81.2	4.39	
Schriever	99	67	81.8	5.01	
Sugar Ex. Station	95	71	81.7	6.98	
Wallace	99	68	81.8	8.21	
White Sulphur Springs	101	62	82.7	2.37	
Maine.					
Bar Harbor	88	43	65.2	3.00	
Belfast	83	48	66.1	3.64	
Bemis	80	42	62.5	2.28	
Calais	84	47	66.8	4.45	
Carmel	83	45	66.2	2.91	
Cornish	87	49	68.7	9.00	
Fairfield	88	50	68.6	3.39	
Farmington	86	45	66.6	3.45	
Flagstaff	84	40	64.1	4.95	
Gardiner	85	52	69.6	5.54	
Kineo	80	50	62.8	2.55	
Lewiston	88	53	69.6	4.75	
Mayfield	83	42	65.6	5.25	
North Bridgton	88	48	68.8	5.46	
Orono	86	43	66.4	3.76	
Rumford Falls	86	45	67.2	3.47	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Maryland.	°	°	°	*Ins.*	*Ins.*
Annapolis	93	64	78.4	10.40	
Bachmans Valley	89	55	73.0	12.04	
Boettcherville	97	53	74.8	9.13	
Boonsboro *a*	92	57	74.6	6.64	
Cambridge	90	65	78.6	......	
Chase	90	58	77.2	5.29	
Cheltenham	90	57	75.3	5.22	
Chestertown	88	57	75.6	6.25	
Chewsville	90	54	73.4	4.33	
Clearspring	90	57	73.6	5.88	
Coleman	......	......	......	2.70	
Collegepark	97[c]	55	74.4[c]	4.93	
Cumberland *b*	......	......	......	7.29	
Darlington	89	56	74.5	7.39	
Deerpark	87[c]	44[c]	76.4[c]	4.74	
Denton	98	55	76.8	5.89	
Easton	91	55	76.5	5.10	
Fallston	89	56	74.3	8.43	
Frederick	91	59	75.9	5.28	
Frostburg	88	51	68.9	5.02	
Grantsville	88	48	68.4	4.34	
Greatfalls	92	......	......	5.55	
Greenspring Furnace	94	56	74.3	7.42	
Hagerstown	95	57	75.3	5.23	
Hancock	96	54	75.2	7.83	
Harney	......	......	......	3.74	
Jewell	88	60	75.5	5.08	
Johns Hopkins Hospital	93	57	75.4	7.14	
Laurel	92	55	75.1	4.36	
Longwoods *f*	......	......	......	4.07	
McDonogh	90	55	73.9	3.23	
Mount St. Marys Coll	89	59	73.4	3.80	
Newmarket	89	58	73.8	7.36	
Pocomoke	93	60	77.2	5.52	
Princess Anne	88	57	75.8	12.05	
Queenstown	91	57	77.3	5.48	
Rockhall *b*	91	54	76.0	4.10	
Sharpsburg	98	60	79.0	5.34	
Smithsburg *a*	95	53	74.0	3.93	
Smithsburg *b*	91	57	74.9	4.16	
Solomons	92	66	78.4	4.93	
Sudlersville	94	60	77.3	......	
Sunnyside	90	42	66.0	5.17	
Takoma Park	89	59	74.3	4.70	
Taneytown	89	56	74.7	5.90	
Van Bibber	89	58	75.8	5.40	
Westernport	92	51	71.4	5.59	
Woodstock	89	59	75.9	4.37	
Massachusetts.					
Amherst	86	52	69.6	5.75	
Bedford	83	54	69.0	3.05	
Bluehill (summit)	85	57	69.4	2.90	
Cambridge	89	56	71.0	3.95	
Chestnuthill	90	54	72.0	4.12	
Cohasset	......	......	......	3.04	
Concord	89	52	69.7	3.26	
East Templeton *[1]	84	60	69.0	5.13	
Fallriver	85	57	70.6	3.01	
Fitchburg *a* *[1]	86	57	69.5	4.50	
Fitchburg *b*	87	54	70.4	4.14	
Framingham	87	52	71.2	4.42	
Groton	89	51	68.8	3.51	
Hyannis	......	......	......	2.18	
Jefferson	......	......	......	4.92	
Lawrence	87	52	70.8	2.28	
Leominster	......	......	......	3.69	
Longplain	......	......	......	3.08	
Lowell *a*	85	55	72.2	3.27	
Ludlow Center	81	48	66.3	7.56	
Middleboro	87	47	69.6	2.43	
Monson	85	53	70.3	5.82	
New Bedford *a*	85	57	70.2	2.24	
Pittsfield	89	49	70.0	7.52	
Plymouth *[1]	85	62	68.7	2.37	
Princeton	......	......	......	4.78	
Provincetown	92	58	72.0	2.37	
Salem	......	......	......	2.83	
Somerset *[1]	94	54	74.6	2.97	
Springfield Armory	86	55	71.8	7.74	
Sterling	......	......	......	3.99	
Taunton	86	46	69.0	3.40	
Webster	......	......	......	5.36	
Westboro	87	56	71.5	4.82	
Weston	85	52	69.4	3.87	
Williamstown	83	56	69.0	7.14	
Winchendon	......	......	......	5.06	
Worcester	87	57	71.4	3.34	
Michigan.					
Adrian	95	48	72.0	2.05	
Agricultural College	90	46	68.4	2.49	
Allegan	90[d]	49[d]	70.4[d]	1.43	
Alma	90	45	68.2	3.04	
Ann Arbor	94	49	72.0	3.14	
Annpere	92	35	71.0	2.34	
Baldwin	90	42	68.4	1.90	
Ball Mountain	90	48	69.9	1.95	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Battlecreek	91	48	70.6	2.11	
Bay City	91	48	68.4	4.57	
Benzonia	86	46	67.4	2.35	
Berlin	91	42	68.8	3.60	
Berrien Springs	95	45	71.9	2.21	
Big Rapids	88	44	66.4	2.51	
Birmingham	93	50	71.2	1.48	
Boon	83[d]	39[d]	62.2[d]	4.51	
Calumet	83	43	64.1	2.86	
Carsonville	90	38	66.2	1.10	
Cassopolis	95	49	72.4	0.72	
Charlevoix	89	53	67.7	2.20	
Chatham	89	36	63.0	1.67	
Cheboygan	86	46	66.9	2.59	
Clinton	93	46	71.6	3.80	
Coldwater	93	47	70.8	4.10	
Deerpark	87	46	64.3	3.03	
Detour	82	48	65.1	2.49	
Dundee	95	49	70.9	5.05	
Eagle Harbor	87	42	64.7	1.51	
East Tawas	89	45	65.8	2.26	
Eloise	92	48	70.8	2.33	
Ewen	89	30	64.8	0.60	
Fairview	92[e]	46	69.0[e]	2.76	
Fennville	91	44	70.2	1.56	
Fitchburg	92	45	68.4	1.83	
Flint	91	44	69.0	2.31	
Frankfort	86	43	66.6	......	
Gaylord	85	37	62.4	5.90	
Gladwin	87	43	66.6	4.30	
Grand Marais	85	44	66.0	2.42	
Grand Rapids	90	50	71.2	2.08	
Grape	96	48	71.4	5.20	
Grayling	87	41	64.6	4.85	
Hanover	94	46	71.4	1.72	
Harbor Beach	90	48	68.3	1.55	
Harrison	85	46	66.3	2.33	
Harrisville	91	47	65.9	4.36	
Hart	88	43	66.8	0.70	
Hastings	94	44	69.5	2.56	
Hayes	88[d]	42[d]	66.9[d]	2.17	
Highland Station	.....	.....	.....	2.13	
Hillsdale	93	44	69.6	2.20	
Humboldt	88	30	60.0	1.46	
Ionia	92	49	70.2	2.70	
Ironwood	87	39	65.8	1.76	
Ishpeming	87	40	64.8	2.46	
Ivan	86	43	64.4	3.67	
Jackson	94	49	71.8	1.70	
Jeddo	91	48	69.3	1.88	
Kalamazoo	91	49	67.8	1.33	
Lake City	89	42	65.6	1.50	
Lansing	90	48	69.0	3.24	
Lapeer	91	44	68.8	2.80	
Lathrop[b]	85	40	61.7	2.65	
Lincoln	86	45	65.0	1.35	
Ludington	89	.....	.....	0.75	
Mackinac Island	81	47	65.4	4.29	
Mackinaw	85	52	68.6	6.46	
Madison	95	48	72.0	1.76	
Mancelona	88	42	67.0	4.59	
Manistique	81	45	65.0	2.43	
Menominee	88	46	67.7	3.02	
Midland	92	49	70.2		
Mio	88	40	64.8	3.61	
Mount Clemens	92	47	69.8	1.37	
Muskegon	88	49	69.2	1.06	
Newberry	92	.....	.....	2.40	
North Marshall	91	48	69.2	2.20	
Old Mission	91	53	68.6	2.71	
Olivet	86	49	68.8	2.00	
Omer	90	58	64.8	1.02	
Onaway	86	40	64.2	3.05	
Ontonagon	92	42	64.6	2.83	
Ovid	92	46	68.6	3.45	
Owosso	94	45	70.4	2.20	
Petoskey	89[d]	46[e]	66.2[d]	4.65	
Plymouth	95	48	75.6	1.25	
Port Austin	92	48	67.0	1.48	
Reed City	87	50	70.8	2.61	
Roscommon	.....	.....	.....	2.50	
Saginaw	94	48	69.2	3.02	
St. Ignace	85	45	62.2	4.08	
St. Johns	93	47	70.1	2.37	
St. Joseph	90	45	69.0	2.38	
Sidnaw	98	32	66.8	1.14	
Somerset	93[g]	46[h]	70.3[g]	2.28[g]	
South Haven	90	48	67.8	1.40	
Stanton	96[d]	40[d]	68.2[d]	2.20	
Thomaston	88	29	64.6	0.60	
Thornville	89	48	69.6	3.39	
Traverse City	93	50	68.9	2.97	
Vassar	91	45	68.6	4.61	
Wasepi	95	48	70.0	1.05	
Waverly	90	42	68.5	1.01	
West Branch	86	41	65.3	3.37	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Whitecloud	90	41	67.8	......	
Whitefish Point	85	48	64.0	3.31	
Williamston[a]	91	47	68.4	1.09	
Ypsilanti	88	51	69.7	3.46	
Minnesota.					
Ada	94	40	65.8	4.28	
Alexandria	94	45	68.8	1.37	
Ashby	94	49	69.8	1.04	
Beardsley	100	45	71.0	1.29	
Bemidji	92	45	68.1	2.09	
Bird Island	98	43	72.6	2.46	
Blooming Prairie	94	43	71.1	1.65	
Brainerd	94	42	69.0	1.15	
Caledonia	89	46	69.2	1.09	
Campbell	96	40	68.6	0.83	
Collegeville	93	47	71.1	1.08	
Crookston	93	45	67.0	2.60	
Currie	100[h]	47[h]	71.8[h]	.....	
Deephaven	.....	.....	.....	1.92	
Detroit City	92	39	66.3	1.55	
Faribault	95	43	72.8	1.68	
Farmington	94	45	72.2	1.29	
Fergus Falls	92	48	68.5	1.69	
Glencoe	94	36	70.4	1.88	
Grand Meadow	98	43	72.7	1.36	
Hallock	93	35	64.5	3.24	
Hovland	.....	.....	.....	3.17	
Lake Jennie	105	44	71.8	3.36	
Lake Winnibigoshish	92	47	67.8	1.67	
Long Prairie	96	42	69.9	1.61	
Luverne	100	51	72.5	2.80	
Lynd	94[i]	45[i]	71.6[i]	3.37	
Mapleplain	96	44	71.2	1.59	
Milaca	93	36	67.2	1.97	
Milan	101	43	72.7	1.22	
Minneapolis *b*[1]	97*	45	71.7	3.54	
Montevideo	99	45	72.0	1.83	
Morris	94	45	69.7	1.08	
Mount Iron	92	38	63.7	1.91	
Newfolden	90	39	64.2	3.48	
New London	100	46	72.0	0.68	
New Richland*[1]	96	52	72.5	.....	
New Ulm	96	49	73.0	1.81	
Park Rapids	92	42	66.1	1.48	
Pine River	92	42	67.8	1.01	
Pipestone	98	50	71.2	3.13	
Pleasant Mounds	94	49	71.5	2.53	
Pokegama Falls	92	35	65.4	1.49	
Redwing *a*	.....	.....	.....	3.74	
Redwing *b*	92	48	72.6	4.68	
Reeds	.....	.....	.....	1.31	
Rolling Green	91	47	71.4	1.80	
St. Charles	95	40	70.6	3.39	
St. Cloud	98	42	71.3	1.54	
St. Peter	92	45	72.6	2.42	
Sandy Lake Dam	90	43	67.2	2.63	
Shakopee	95	45	71.7	1.37	
Thief River Falls	.....	.....	.....	4.65	
Tower	93	32	62.0	1.70	
Two Harbors	86	42	64.7	2.65	
Wabasha*[3]	.....	48	68.7	1.32	
Warroad[c]	91	35	64.8	3.95	
White Bear	98	45	74.6	1.73	
Willmar	93	43	71.0	1.70	
Willow River	94	37	68.2	3.70	
Winnebago City	94	42	72.4	2.38	
Worthington	93	49	70.6	2.91	
Wyoming	.....	.....	.....	2.78	
Zumbrota[1]	92*	42	71.8	.....	
Mississippi.					
Aberdeen	102	55	77.0	7.29	
Agricultural College	104	65	80.7	8.16	
Austin	99	59	78.8	5.78	
Batesville	105	56	79.2	7.71	
Bay St. Louis	93	66	81.4	10.42	
Biloxi	95[e]	68[h]	81.2[e]	9.47	
Booneville	103	65	78.0	8.53	
Brookhaven	102	66	81.0	4.40	
Canton	98	62	80.3	2.39	
Cleveland	102	59	81.2	8.56	
Columbus *a*	.....	.....	.....	7.47	
Columbus *b*	99	64	79.6	7.65	
Corinth	103	58	78.2	12.45	
Crystalsprings	100	64	80.3	7.54	
Edwards	99	67	82.4	3.07	
Fayette	94	65	80.3	7.00	
Fayette (near)*[1]	96	73	82.5	6.26	
Greenville *a*	96	69	81.0	2.52	
Greenville *b*	101	68	82.0	2.47	
Hattiesburg	97	67	82.6	8.69	
Hazlehurst	99	65	81.3	6.39	
Hernando	103	63	80.1	5.50	
Holly Springs	101	62	78.5	5.82	
Indianola	97	62	79.1	5.38	
Jackson	100	65	80.8	5.57	
Kosciusko	105	57	79.0	7.32	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Mississippi—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lake	98	59	77.8	3.34	
Leakesville	99	63	81.2	13.01	
Louisville	100	61	79.0	14.13	
Macon	104	61	80.2	7.53	
Magnolia	96	64	80.2	3.99	
Natchez	97	65	81.7	3.35	
Nittayuma	98	63	80.5	0.86	
Okolona	103	59	78.8	5.01	
Palo Alto	100	66	79.2	6.96	
Pearlington	99	67	81.0	11.32	
Pittsboro	102	60	79.0	8.75	
Pontotoc	99	60	77.6	12.78	
Port Gibson	97	63	81.8	3.49	
Ripley	101	58	76.8	8.54	
Saratoga	98	63	80.0	12.60	
Shoccoe	.....	.....	.....	5.23	
Stonington*[1]	94	68	80.0	6.35	
Suffolk	95	63	79.5	5.87	
Swartwout	101	60[j]	80.2[e]	13.24	
Thornton	100	65	81.0	10.00	
Tupelo	.....	.....	.....	9.46	
Walnutgrove	95[f]	66[f]	79.1[f]	5.12	
Watervalley	105	63	80.8	5.48	
Waynesboro	98	66	82.0	5.30	
Woodville	96	67	81.0	5.84	
Yazoo City	100	64	81.0	6.75	
Missouri.					
Appleton City	105	59	80.1	3.51	
Arthur	103	57	78.2	4.62	
Avalon	103	55	80.0	0.54	
Bethany	100	47	75.2	1.46	
Birchtree	102	51	79.0	0.60	
Boonville	.....	.....	.....	2.28	
Brunswick	97	60	77.6	1.25	
Carrollton	98	61	78.0	2.48	
Conception	96	56	75.8	1.16	
Cowgill*[5]	102	60	80.0	1.79	
Darksville	98	56	77.2	1.55	
Dean	103	54	79.0	4.48	
Desoto	108	55	80.0	0.12	
Downing	.....	.....	.....	0.28	
Edgehill*[5]	100	60	77.5	1.19	
Edwards	101	54	76.8	2.93	
Eightmile*[3]	.....	62	75.3	3.46	
Eldon	105	56	78.6	2.39	
Fairport	.....	.....	.....	1.20	
Fayette	103	57	79.4	1.06	
Fulton	104	56	77.6	2.38	
Galena	.....	.....	.....	1.36	
Gallatin*[1]	100	55	79.4	0.37	
Gayoso	97	57	77.4	2.79	
Glasgow	103	58	79.2	0.54	
Gorin	.....	.....	.....	0.18	
Halfway	102	55	78.6	2.67	
Harrisonville	104	59	78.8	3.93	
Hazlehurst	.....	.....	.....	0.46	
Hermann	.....	.....	.....	2.35	
Houston	102	52	78.4	1.43	
Irena	.....	.....	.....	0.69	
Ironton	105	50	77.8	1.41	
Jackson	102	49	76.5	4.44	
Jefferson City	109	58	80.8	2.12	
Kidder	96	55	77.6	1.27	
Koshkonong	101	60	80.0	1.47	
Lamar	102	60	80.4	3.50	
Lamonte	.....	.....	.....	2.25	
Lebanon	103	58	79.9	1.93	
Lexington	103	56	79.5	1.80	
Liberty	103	58	78.6	0.82	
McCune*[1]	100	63	78.3	1.11	
Macon	100	56	78.0	0.69	
Marblehill	105	52	77.0	4.58	
Marshall	102	57	78.6	1.73	
Maryville	103	54	76.6	2.31	
Mexico	102	56	79.2	0.65	
Miami*[5]	98	61	79.6	1.00	
Mineralspring	101	56	78.6	3.08	
Monroe City	96	53	75.8	0.75	
Montreal	100	52	76.8	2.65	
Mountaingrove	100	53	78.4	1.21	
Mount Vernon	106	58	81.2	4.84	
Neosho	99	53	77.6	4.07	
Nevada	.....	.....	.....	2.02	
New Haven	105	57	80.0	1.70	
New Madrid *a*	99	63	79.5	......	
New Madrid *b*	.....	.....	.....	5.21	
New Palestine	103	58	79.2	1.32	
Oakfield	107	58	80.0	2.30	
Olden	101	59	79.1	1.28	
Oregon *a*	99	57	77.4	2.73	
Palmyra*[5]	98	60	77.9	0.27	
Phillipsburg*[1]	101	64	77.6	1.88	
Pine Hill	.....	.....	.....	2.68	
Poplarbluff	109	54	79.2	3.69	
Potosi	104	51	77.2	1.45	
Princeton	100	54	77.6	0.44	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
***Missouri*—Cont'd.**	°	°	°	*Ins.*	*Ins.*
Richmond	102	59	79.4	1.59	
Rockport				1.23	
Rolla				1.59	
St. Charles	108	60	79.6	1.22	
St. Joseph				1.73	
Sarcoxie *3		64	76.6	3.42	
Seymour	101	53	78.1	2.97	
Shelbina				0.15	
Sikeston	102	54	77.6	6.98	
Steffenville	99	55	78.8	0.27	
Sublett	100	53	76.6	0.47	
Trenton	97	56	77.0	0.61	
Unionville	101	54	78.6	0.79	
Vichy	100	57	79.4	3.22	
Warrensburg	104	57	79.7	2.65	
Warrenton	105	56	79.5	1.83	
Wheatland				2.56	
Willowsprings	101	57	77.4	0.57	
Windsor	104	58	79.2	1.95	
Zeitonia	106	53	78.8	1.19	
Montana.					
Adel	92	29	60.2	0.29	
Anaconda	92	40	65.2	T.	
Augusta	89	42	64.2	0.07	
Billings	100	46	71.9		
Boulder	97	42	64.8	0.35	
Butte	85	38	62.8	0.30	
Canyon Ferry	96	44	70.8	0.09	
Chester	98	38	67.8	0.03	
Columbia Falls				0.60	
Corvallis	100	36	75.1	0.00	
Crow Agency	96	44	71.8	0.70	
Culbertson	100	41	69.6	0.37	
Deerlodge	99			0.00	
Dell	90	38	64.4	1.12	
Fort Benton	96	44	68.3	0.20	
Fort Logan	85	36	61.4	0.85	
Glendive	104	46	71.8	0.15	
Glenwood	91	36	64.2	1.66	
Greatfalls	94	48	69.8	0.12	
Kipp	94	35	65.6	1.41	
Lewistown	95	40	65.8	0.02	
Livingston	99	45	69.8	0.62	
Manhattan	94	37	66.0	0.07	
Martinsdale	95	40	64.4	1.45	
Marysville	88	42	65.4	0.01	
Ovando	94	29	60.2	0.10	
Parrot	93	43	68.4	0.60	
Plains	95	45	68.0	0.25	
Poplar	101	43	70.6	0.68	
Ridgelawn	103	42	68.4	0.07	
St. Pauls	95	38	67.6	0.61	
St. Peter	90	36	61.4	0.21	
Troy	97	39	65.4	0.59	
Utica	97	41	68.0	0.90	
Yale	103	40	65.2	0.70	
Nebraska.					
Agate				1.70	
Agee *1	108	54	75.0	2.17	
Albion	101	50	73.4	0.49	
Alliance	103	46	72.9	1.70	
Alma	107	53	77.7	1.83	
Ansley	99	41	71.0	2.35	
Arapahoe *1	100	60	79.8	4.63	
Arborville *1	106	62	77.8	4.39	
Arcadia				3.80	
Arlington				0.78	
Ashland *a*	104	53	76.8	1.12	
Ashland *b* *1	104	60	78.4	1.01	
Ashton				1.25	
Auburn	102	51	75.8	2.11	
Aurora	102	52	75.2	4.69	
Bartley				4.59	
Beatrice	104	52	76.6	3.25	
Beaver	105	51	77.8	4.96	
Bellevue				1.07	
Benedict				2.78	
Benkleman				4.95	
Blair	101	56	74.8	0.95	
Bluehill *1	103	62	78.0	1.42	
Bradshaw				3.86	
Brokenbow *1	101	46	73.6	1.03	
Burchard				2.10	
Burwell				2.05	
Callaway	100	51	73.8	3.85	
Camp Clarke	105	48	74.4	2.21	
Central City				2.62	
Chester				2.16	
Cody				1.00	
Columbus	100	52	74.2	0.60	
Crete	101	55	76.4	2.68	
Culbertson				2.71	
Curtis	101[h]	50[h]	75.6[h]	2.01	
Dannebrog				2.13	
David City	99	54	74.8	1.65	
Dawson	104	56	78.4	2.52	
***Nebraska*—Cont'd.**	°	°	°	*Ins.*	*Ins.*
Eden				2.44	
Edgar *a* *5	102	58	80.2	1.31	
Ericson				0.97	
Ewing				0.75	
Fairbury	108	52	77.0	2.91	
Fairmont	101	52	74.6	2.83	
Fort Robinson	97	42	72.4	1.16	
Franklin	104	41	76.8	2.01	
Fremont	103	53	74.4	1.14	
Fullerton				3.31	
Geneva	104	52	76.0	2.41	
Genoa	103	53	76.5	0.61	
Gering	101	48	73.7	1.64	
Gordon				1.00	
Gosper				5.16	
Gothenburg	101	49	73.0	3.58	
Grand Island *a* *1	99	60	75.4	2.44	
Grand Island *b*	104	51	77.8	2.73	
Grand Island *c*	104	52	77.4	3.08	
Greeley				1.29	
Guide Rock				2.21	
Haigler				5.69	
Hartington	105	50	73.6	2.35	
Harvard	100	54	75.9	2.13	
Hastings *1	100	62	78.4	1.33	
Hayes Center				3.35	
Hay Springs	97[e]	50[e]	72.2[e]	3.30	
Hebron	105	53	77.3	2.30	
Hickman				1.50	
Holbrook				3.20	
Holdrege				3.25	
Hooper *1	98	56	73.5	2.35	
Imperial	102	50	75.0	2.76	
Johnstown				1.63	
Kearney	101	54	75.8	4.17	
Kennedy	105	55	77.0	2.80	
Kimball	98	49	71.8	0.72	
Kirkwood *1	101	57	73.0	2.24	
Laclede	103	52	75.7	1.71	
Lexington	101	48	73.7	2.99	
Lodgepole	96	45	72.0	3.00	
Loup				2.54	
Lynch	104	48	73.9	3.21	
Lyons				1.19	
McCook *1	101	59	78.0	4.56	
McCool				3.96	
Madison	100	50	74.6	0.71	
Madrid				2.14	
Marquette				1.00	
Mason City				3.09	
Minden *a*	103	51	75.7	3.22	
Monroe				0.84	
Nebraska City *b* *1				2.54	
Nebraska City *c*	101[d]	54[d]	76.3[d]	2.35	
Nemaha *1	100	62	80.4	2.30	
Nesbit	100	45	73.0	4.00	
Norfolk	103	49	74.2	0.86	
North Loup	103	46	75.6	1.64	
Oakdale	104	50	74.6	0.80	
Odell				2.57	
O'Neill	105	52	73.8	1.22	
Ord				1.81	
Osceola				0.95	
Ough				5.19	
Palmer				1.50	
Palmyra *1	100	60	75.2	1.60	
Plattsmouth *b*	103	54	75.6	1.57	
Pleasanthill				5.29	
Ravenna *a*	101	52	75.8	2.88	
Ravenna *b*				2.71	
Redcloud *b*	103	50	77.0	3.68	
Republican *1	100	60	78.5	2.91	
Rulo *1	98	67	79.3	2.95	
St. Libory				1.34	
St. Paul	102	51	75.7	1.14	
Salem *1	98	64	77.1	2.55	
Santee	100[e]	52[e]	75.2[e]	2.44	
Schuyler				0.65	
Seneca *1	99	50	74.4		
Seward	100	56	75.4	1.98	
Smithfield				3.14	
Spragg				2.27	
Springview	105	50	72.8	2.72	
Stanton	101	48	73.6	0.71	
State Farm	104	50	76.8	0.91	
Strang				1.90	
Stratton				4.02	
Superior	102	50	77.6	1.35	
Syracuse				3.40	
Tablerock				2.42	
Tecumseh *b*	100	53	76.3	4.27	
Tecumseh *c*				4.59	
Tekamah	102	55	76.2	0.76	
Turlington	103	55	76.2	2.29	
Wakefield	104	46	73.0	1.69	
Wallace				0.54	
***Nebraska*—Cont'd.**	°	°	°	*Ins.*	*Ins.*
Wauneta				7.19	
Weeping Water	100	48	73.0	3.36	
Westpoint	107	50	76.9	2.19	
Whitman				1.85	
Wilber *1	104	60	76.8	3.40	
Willard				1.58	
Wilsonville				3.44	
Winnebago				3.45	
Wisner				1.76	
Wymore				3.02	
York	101	51	76.3	4.85	
Nevada.					
Amos	100	33	67.6	0.24	
Austin	87	50	68.6	1.84	
Battle Mountain *1	93	50	70.2	0.13	
Belmont	88	45	64.8	2.74	
Beowawe *1	101	60	77.3	0.30	
Candelaria	97[j]	53[j]	72.1[j]	1.09[e]	
Carlin *1	100	50	77.2	0.20	
Carson City	94	38	67.6	0.44	
Cranes Ranch				1.66	
Elko (near)	96	29	62.1	2.05	
Ely	92	39	65.8	2.44	
Fenelon *1	90	50	70.0		
Golconda *1	90	54	71.6	0.37	
Halleck *1	98	46	69.0	0.12	
Hamilton	95	35	66.8	1.74	
Hawthorne	100	52	74.4	0.00	
Hot Springs *1	118	70	84.4	1.00	
Humboldt *1	90	64	76.0	0.90	
Lee				2.32	
Lewers Ranch	95	39	68.8	0.75	
Lovelocks *a*	100	52	75.1	0.45	
Lovelocks *b* 1 *	100	41	72.0	0.44	
Martins	98	38	69.2	0.47	
Mill City *1	101	50	77.4	1.20	
Owyhee	93	33	67.3	0.78	
Palisade *1	97	44	76.3	0.21	
Palmetto	93	35	64.1	7.79	
Potts	91	43	70.4	2.88	
Reno State University	93	44	69.2	1.60	
Tecoma *1	100	50	74.6	0.50	
Toano *5	97	60	78.2	1.52	
Tybo	95	46	68.8	4.50	
Verdi *1	92	45	61.8	0.50	
Wadsworth *1	102	60	81.0	1.92	
Wells *1	92	56	69.8	0.00	
Wood	91	41	66.4	1.02	
New Hampshire.					
Alstead	82	49	68.0	5.31	
Berlin Mills	88	38	66.3	2.84	
Bethlehem	82	45	66.6	3.10	
Brookline *1	88	60	71.0	5.12	
Chatham	87	46	67.2	5.33	
Concord	87	47	68.9	6.68	
Durham	88	55	68.4	1.08	
Franklin Falls	82	51	68.7	4.56	
Grafton	86	40	66.6	4.36	
Hanover	89	45	67.7	3.28	
Keene	86	48	68.8	6.37	
Littleton	83	44	65.9	2.69	
Nashua	89	53	70.9	3.30	
Newton	86	49	67.8	2.99	
Peterboro	88	45	68.0	6.36	
Plymouth	89	44	68.6	4.37	
Sanbornton	85	48	67.8	4.85	
Stratford	87	41	66.6	3.20	
New Jersey.					
Asbury Park	88	61	73.9	6.42	
Bayonne	93	58	75.0	8.95	
Belvidere	90	54	73.4	8.58	
Bergen Point	89	57	73.6	9.63	
Beverly	92	56	75.4	11.70	
Bridgeton	93	56	77.8	7.93	
Camden	92	60	75.4	11.82	
Cape May C. H.	91	57	75.8	5.37	
Charlotteburg	80	44	67.6	12.11	
Chester	88	51	70.8	11.60	
Clayton	92	56	75.4	15.62	
College Farm	90	55	74.6	8.90	
Dover	92	50	71.5	12.87	
Egg Harbor City	88	54	73.6	6.54	
Elizabeth	92	56	74.0	9.82	
Englewood	89	58	73.4	10.37	
Flemington	90	55	74.3	8.06	
Freehold	90	56	72.6	9.36	
Friesburg	91	54	75.5	10.78	
Hanover	88	52	71.7	11.69	
Hightstown	88	57	73.6	9.72	
Imlaystown	90	58	74.7	9.57	
Indian Mills	94	55	76.6	10.25	
Lakewood	90	57	73.4	11.38	
Lambertville	91	55	74.2	9.22	
Layton	92	45	70.8	6.26	
Moorestown	90	57	74.8	10.37	
Mount Pleasant				8.52	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Temperature. (Fahrenheit.) Minimum.	Temperature. (Fahrenheit.) Mean.	Precipitation. Rain and melted snow.	Precipitation. Total depth of snow.
New Jersey—Cont'd.	°	°	°	*Ins.*	*Ins.*
Newark	91	56	72.6	11.94	
New Brunswick	92	57	75.3	9.49	
New Egypt				8.81	
Newton	91	51	72.2	8.36	
Oceanic	88	59	73.5	4.88	
Paterson	90	57	73.0	10.62	
Perth Amboy	95	59	74.2	10.13	
Plainfield	91	54	73.3	10.10	
Rancocas				12.13	
Rivervale	90	49	72.0	7.04	
Roseland	89	50	71.2	10.37	
Salem	95	55	76.8	10.99	
Somerville	92	54	74.3	7.40	
South Orange	88	57	72.4	12.80	
Sussex	88	50	71.0	8.42	
Three Bridges				6.92	
Trenton	90	61	75.2	10.13	
Tuckerton	88	54	74.6	7.75	
Vineland	98	56	75.4	9.70	
Woodbine	92	55	74.8	8.34	
Woodstown				11.19	
New Mexico.					
Alamagordo	104	61[c]	80.2[c]	1.14	
Albert	98	58	77.0[i]	5.00	
Albuquerque	92	57	76.0	1.85	
Alma	100	51	74.2	2.03	
Aztec [1]	99	49	76.6	1.16	
Bellranch				1.65	
Bluewater	94	47	71.4	0.80	
Cambray				0.19	
Carlsbad	102	62	81.6	1.35	
East Lasvegas	83	56	68.4	4.95	
Engle	96	58	77.6	1.07	
Espanola	96	52	73.0	2.09	
Folsom	89	51	68.2	4.61	
Fort Bayard	92	55	73.6	0.90	
Fort Stanton	88[e]	49[e]	69.5[e]	1.85	
Fort Union	89	45	68.4	3.71	
Fort Wingate	97	40	72.2	2.34	
Gage				2.08	
Galisteo	88	50	70.2	3.76	
Gallinas Spring	99	50	75.0	2.11	
Horse Springs	90	47	69.2	3.75	
Las Vegas	93	46	69.6	4.57	
Las Vegas Hotsprings	86	49	67.2	7.45	
Lordsburg				0.95	
Lower Penasco	90	57	73.0	0.97	
Mesilla Park	102	55	79.8	1.35	
Raton	92	50	69.6	1.80	
Roswell	100	57	79.2	0.60	
San Marcial	105	60	80.0	0.01	
Socorro	97	60	81.2	0.99	
Springer	94	48	71.2	1.99	
Strauss				3.10	
Woodbury	94	51	72.8	3.72	
New York.					
Adams				5.79	
Addison	88	45	69.6	6.22	
Adirondack Lodge	81	48	64.0	5.24	
Akron				4.30	
Alden	87	46	69.2	8.13	
Angelica	90	39	67.4	4.87	
Appleton	88	50	69.4	1.71	
Atlanta	87	44	67.9	9.08	
Atwell	84	35	65.3	3.86	
Auburn	90	52	71.4	6.49	
Avon	88	47	69.0	4.52	
Axton	85	35	63.0	6.32	
Baldwinsville	91	54	71.2	3.86	
Bedford *a*	89	52	72.4	15.36	
Blue Mountain Lake				6.00	
Bolivar	89	40	66.8	3.67	
Bouckville	85	49	67.7	3.44	
Boyds Corners				8.21	
Brockport	85	52	69.0	1.80	
Caldwell	82	51	68.0	4.85	
Canaan Four Corners	85	50	68.5	7.59	
Canajoharie	86	50	68.2	3.25	
Canton	88[d]	45	67.2	4.91	
Carmel	88	54	72.5	7.74	
Carvers Falls	85	49	68.2	3.57	
Catskill	86	56	72.0	3.35	
Cedarhill	88	53	71.7	5.34	
Chenango Forks				3.85	
Cooperstown	84	50	67.4	5.96	
Cortland				3.83	
Cutchogue	88	55	72.4	3.92	
Dekalb Junction				5.66	
Easton				4.29	
Elba	89	50	69.1	2.45	
Elmira	87	52	70.8	4.07	
Fayetteville	90	50	70.8	4.30	
Franklinville	87	40	67.2	5.92	
Fulton				6.02	
Gabriels	82	42	64.4	4.11	
Glens Falls	86	55	70.2	4.70	
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Gloversville	85	50	68.2	4.19	
Greenwich [h]	85	52	69.7	4.81	
Griffin Corners	88	42	66.8	6.22	
Haskinville				5.67	
Hemlock	86	52	70.4	5.01	
Honnedaga Lake				5.23	
Humphrey	85	42	66.1	4.83	
Indian Lake	85[d]	41[d]	64.8[d]	5.62	
Ithaca	89	50	69.5	3.85	
Jay	88	44	68.0	2.94	
Keene Valley	84	45	66.8	3.65	
King Ferry				4.77	
King Station				4.96	
Liberty	82	50	66.7	5.00	
Littlefalls, City Res.	88	51	68.6	2.56	
Lockport	89	54	72.4	1.60	
Lowville	87	48	67.6	6.37	
Lyndonville				0.94	
Lyons [c]	92	52	73.2	4.01	
Mayle				1.80	
Meredith	85	48	66.6	5.35	
Middletown	86	56	71.6	8.50	
Mohonk Lake	82	56	67.6	9.53	
Moira	88	46	68.0	6.40	
Newark Valley				4.36	
New Lisbon	86	43	65.1	5.60	
New Rochelle	90	49	71.6	4.20	
North Hammond	88	50	69.9	5.16	
Number Four	87	42	65.3	5.82	
Ogdensburg	86	54	69.4	4.37	
Old Chatham				4.79	
Oneonta	93	47	68.6	4.45	
Oxford	85	45	67.8	4.33	
Palermo	90	45	68.7	5.30	
Penn Yan	89	54	70.9	6.17	
Perry City	89	46	67.3	7.37	
Plattsburg Barracks	84	45	69.4	4.48	
Port Byron	90	49	69.2	5.00	
Port Jervis	89	51	71.7	5.64	
Primrose	90	52	72.9	8.33	
Redhook				7.68	
Richmondville	86	49	68.0	5.38	
Ridgeway	86	53	70.0	1.40	
Rome	88	50	67.4	2.23	
Romulus	89	52	70.2	3.62	
Salisbury Mills				9.10	
Saranac Lake (near)	84	41	65.4	3.74	
Saratoga Springs	87	53	70.4	4.73	
Schenectady	87	54	71.6	3.42	
Scottsville				4.80	
Setauket	86	56	71.8	6.02	
Shortsville	87	52	69.0	5.60	
Skaneateles				5.80	
Southampton	85	55	71.6	5.48	
South Berlin				5.35	
South Canisteo	85	42	66.8	5.93	
Southeast Reservoir				7.98	
South Kortright	86	45	67.0	3.87	
South Schroon	82	44	65.6	3.85	
Ticonderoga	84	53	69.8	2.18	
Volusia	87	49	68.5	3.32	
Walton	88	44	67.6	5.91	
Wappingers Falls	89	55	72.4	9.42	
Warwick				10.07	
Watertown	91	48	70.2	4.26	
Waverly	89	45	69.7	5.83	
Wedgwood	86	51	68.5	9.42	
Wells	87	44	66.6	7.67	
West Berne	87	47	68.8	4.54	
West Chazy	84	44	67.5		
Westfield *a*	89	52	70.1	3.44	
Westfield *b*	87	52	69.8	4.44	
Westfield *c*	85	52	70.4	3.18	
Windham	87	46	68.4	5.36	
Wolcott				3.65	
North Carolina.					
Abshers	92	54	73.8	15.29	
Asheville				10.04	
Biltmore	86	59	70.3	13.49	
Bryson City				13.26	
Chapelhill	98	64	80.4	11.25	
Cherryville	91	60	74.9	12.82	
Currituck				4.37	
Fayetteville	91	65	78.3	7.80	
Flatrock	87	51	70.8	30.34	
Goldsboro	96	66	79.2	7.52	
Greensboro	91	62	75.8	13.04	
Henderson	91	64	77.0	9.22	
Hendersonville	91	53	71.5	26.58	
Henrietta	91	64	76.4	14.20	
Highlands	80	49	65.2	30.74	
Horse Cove	83	57	69.0	26.43	
Kinston	96	65	80.0	7.63	
Lenoir	94[c]	56[d]	75.2[j]	21.78	
Littleton	92	60	77.0	7.42	
Louisburg	92	64	77.8	12.40	
North Carolina—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lumberton	94	68	80.0	6.97	
Marion [1]	98	57	76.8	21.83	
Marshall				14.42	
Mocksville	93	61	75.8	9.34	
Moncure	91	64	77.6	11.65	
Monroe	91	58	75.9	14.00	
Morganton	92	50	75.0	14.70	
Mountairy	90	57	73.7	16.59	
Murphy				10.77	
Newbern	93	66	80.4	8.01	
Oakridge	93	59	75.4	13.41	
Patterson *[1]	86	57	69.6	24.19	
Pittsboro	93	61	78.0	9.55	
Redsprings	92	68	79.0	7.75	
Rockingham	90	65	78.4	12.45	
Roxboro	90	60	75.8	11.93	
Salem	93	60	76.3	9.51	
Salisbury	93	60	78.2	9.69	
Saxon	94	60	76.4	15.62	
Selma	94	64	79.2	6.16	
Settle	90	62	77.3	10.38	
Sloan	92	65	76.9	7.42	
Soapstone Mount	90	54	75.0	14.69	
Southern Pines *a*	96	64	80.2	13.43	
Southern Pines *b*	92	66	78.6	11.46	
Southport	92	69	81.0	6.67	
Springhope *[1]	95	67	77.7	11.06	
Tarboro	99	64	80.4	11.61	
Washington	99	69	82.4	6.13	
Waynesville [k]	85	47	69.6	8.76	
Weldon *a*	94	65	77.4	11.07	
Weldon *b*				10.96	
North Dakota.					
Amenia	97	42	69.0	1.98	
Ashley	96	37	67.6	2.84	
Berlin	96	33	66.5	1.04	
Buxton	93	42	66.0	2.85	
Cando	92	35	62.2	1.74	
Churchs Ferry	95	40	64.2	2.88	
Coalharbor	95	43	68.0	0.48	
Devils Lake	95	42	66.8	2.20	
Dickinson	98	44	70.4	0.45	
Dunseith	91	33	63.6	0.97	
Edgeley	97	40	70.0	1.05	
Ellendale	100	40	69.1	2.23	
Fargo	97	39	67.4	1.59	
Forman	98	41	70.2	1.37	
Fort Berthold	99	41	70.2	0.15	
Fort Yates	95	42	70.3	2.80	
Fullerton	98	37	68.6	2.21	
Gallatin	94	34	62.2	3.37	
Grafton	90	41	65.8	4.75	
Hamilton	95[c]	40[c]	65.0[c]	2.39	
Hannaford	94	37	65.6	2.04	
Jamestown	94	38	66.8	2.80	
Langdon	94	37	61.7	1.35	
Larimore	94	32	63.2	2.41	
Lisbon	98	43	68.5	1.34	
McKinney	96	35	64.5	0.49	
Mayville	96	42	67.8	3.63	
Medora	100	44	70.0	0.41	
Melville	93	43	66.6	1.67	
Minto	95	38	65.2	3.71	
Napoleon	97	40	68.9	1.99	
New England	95	42	67.9	1.15	
Oakdale	90	48	68.1	0.20	
Pembina	94	37	63.4	2.25	
Portal	94[n]	33[d]	61.2[j]	0.67	
Power	99	39	69.5	1.33	
Steele	95	42	67.4	1.28	
University	90	41	64.7	5.40	
Valley City	98	38	67.0	2.55	
Wahpeton	96	40	68.1	1.06	
Willow City	93	34	64.1	0.90	
Woodbridge	96	33	63.4	1.37	
Ohio.					
Akron	93	52	71.6	4.20	
Annapolis	89	50	70.7	3.85	
Ashtabula	87	52	71.0	2.45	
Atwater				2.68	
Bangorville	95	53	73.0	3.21	
Belfast				2.21	
Bellefontaine	91	55	72.7	1.90	
Bement				5.77	
Benton Ridge	97	49	73.2	2.02	
Bethany	101	57	76.3	1.77	
Bigprairie	95	47[g]	72.0[d]	6.55	
Binola				4.49	
Bloomingburg	97	53	74.4	1.44	
Bowling Green	95	47	71.6	4.38	
Bucyrus	99	48	73.6	1.87	
Cambridge	94	49	73.0	4.12	
Camp Dennison	101	54	76.1	2.08	
Canaan				3.17	
Canal Dover	95	47	72.4	3.71	
Canton	92	49	72.7	3.35	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Cardington	95	45	72.0	4.62	
Cedarville				2.72	
Celina	95c	46c	72.4c	1.86	
Chillicothe	98	55	76.4	3.31	
Circleville	94	54	74.0	2.59	
Clarksville	96	53	74.6	2.84	
Cleveland *a*	88	55	71.3	5.44	
Cleveland *b*	93	55	71.9	6.27	
Clifton	95	51	73.2	2.30	
Coalton	94	52	74.4	3.67	
Colebrook	89b	46	70.2i	5.22	
Dayton *a*				1.19	
Dayton *b*	99	55	75.8	0.91	
Defiance	96	43	73.1	2.16	
Delaware	96	48	72.9	3.33	
Demos	90	52	72.4	3.74	
Elyria	95	49	72.2	4.22	
Findlay	98	49	74.5	2.96	
Frankfort	91	50	72.2	2.75	
Fremont	93	52	72.4	2.83	
Garrettsville	93	46	70.0	4.63	
Granville	94	50	73.1	5.28	
Gratiot	93	51	73.2	5.59	
Green	96	56	75.1	5.94	
Greenfield	93	54	73.9	1.65	
Greenhill	90	45	70.6	4.95	
Greenville	91	55	72.8	2.60	
Hanging Rock	96	58	74.8	3.02	
Hedges	94	44	72.7	2.25	
Hillhouse	92	46	69.2	2.57	
Hillsboro	93	52	73.6	1.76	
Hiram	90	54	71.0	4.55	
Hudson	95	48	71.1	5.11	
Jacksonboro	101	58	76.6	1.15	
Killbuck	94	50	72.4	4.98	
Lancaster	93	53	73.3	2.92	
Leipsic				2.14	
Lima				3.09	
McConnelsville	93	53	73.2	3.42	
Manara	93	52	73.0	1.64	
Mansfield				4.40	
Marietta	92	58	75.0	3.38	
Marion	96	49	74.2	2.33	
Medina	93	46	72.4	2.95	
Milfordton	95	50	72.8	3.10	
Milligan	94	48	72.6	3.28	
Millport	90	45	71.2	4.01	
Montpelier	94	48	71.8	2.45	
Moorfield	97	46	73.2	4.50	
Napoleon	95	51	72.8	2.53	
New Alexandria	94	53	74.7	3.15	
New Berlin	94	51	72.6	2.07	
New Bremen	95	49	73.9	2.11	
New Lexington				2.36	
New Paris	94	53	73.8	6.13	
New Richmond	98	58	76.5	1.42	
New Waterford	91	44	71.3	7.21	
North Lewisburg	95	52	73.0	3.70	
North Royalton	93	51	72.1	3.37	
Norwalk	96	55	73.4	3.53	
Oberlin	96	46	71.4	2.51	
Ohio State University	94	52	73.0	0.95	
Orangeville	91	42	69.9	2.03	
Ottawa	96	47	73.8	2.61	
Pataskala	93	52	72.1	4.22	
Philo	95	53	75.0	3.97	
Plattsburg	94	51	73.5	0.83	
Pomeroy	95	51	74.5	2.58	
Portsmouth *a*				5.94	
Portsmouth *b*	94	58	75.1	6.00	
Pulse				1.44	
Red Lion				1.99	
Richfield				4.15	
Richwood	95	48	73.1	1.99	
Ripley	95	53	74.4	2.37	
Rittman	92	46	71.3	3.81	
Rock				3.51	
Rockyridge	97	50	72.6	4.16	
Rosewood	95	48	72.8	3.08	
Shenandoah	94	49	71.2	4.51	
Sidney	98	53	75.6	2.50	
Sinking Spring	97			2.60	
Somerset	95	55	74.6	3.24	
Springfield				2.32	
Strongsville				7.46	
Swanton				2.55	
Thurman	99	54	75.8	1.79	
Tiffin	93	51	73.0	2.52	
Upper Sandusky	98	47	72.6	1.84	
Urbana	91	56	73.2	2.50	
Vanwert	95	47	73.0	1.50	
Vermillion	94	52	71.4	3.14	
Vickery	98	48	72.6	4.66	
Walnut				3.19	
Warren	94	47	72.2	4.22	
Warsaw	96	43	72.1	9.06	
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Wauseon	97	47	73.0	1.93	
Waverly	96	56	75.4	3.92	
Waynesville *b*	98	55	74.8	2.85	
Wellington	96	47	72.2	3.63	
Willoughby				2.89	
Wooster	94	47	71.6	3.58	
Zanesville				6.13	
Oklahoma.					
Arapaho	108	64	84.9	0.21	
Beaver	105	61	80.6	0.58	
Blackburn	108	55	81.	1.20	
Burnett	107	57	81.6	1.99	
Chandler	107	60	81.4	0.31	
Clifton	107	59	82.3	1.41	
Enid	109	56	83.2	1.05	
Fort Reno	108	63	82.9	1.93	
Fort Sill	107	63	83.2	0.55	
Hennessey	111	60	82.6	0.43	
Jefferson	108	58	80.5	1.46	
Jenkins	106	57	79.5	0.88	
Kenton	100	44	72.4	3.42	
Kingfisher	109	53	83.1	3.31	
Lyons	107	61	82.0	2.17	
Mangum	110	64	84.8	1.00	
Newkirk	105	61	82.7	1.06	
Norman	107	58	81.7	2.14	
Pawhuska	107	58	81.9	0.65	
Perry	109	61	81.6	1.12	
Sac and Fox Agency	110	58	80.2	0.23	
Shawnee	106	61	82.8	0.95	
Stillwater	107	60	82.7	1.95	
Taloga				3.38	
Vittum	105	63	82.9	0.51	
Waukomis	112	59	83.2	0.61	
Weatherford	107	62	84.2	0.71	
Woodward	107	55	82.2	1.75	
Oregon.					
Albany *a* *1	97	52	69.4	0.00	
Albany *b*				0.16	
Alpha	100	38	64.0	T.	
Arlington	103	51	75.6	0.02	
Ashland *b*	105	43	72.4	0.54	
Aurora *1	100	53	70.6	0.30	
Aurora (near)	98	46	66.6	0.24	
Bay City	80	44	57.4	0.17	
Bend	97	35	65.8		
Beulah	106	33	71.6	1.27	
Blalock	107	54	79.6	0.18	
Brownsville *1	102	54	73.1	0.00	
Bullrun	90	47	64.8	0.12	
Burns	96	39	68.6	0.22	
Cascade Locks	104	54	72.8	0.19	
Cloud Cap Inn	81	40	60.2		
Coquille				0.80	
Corvallis	101	40	67.4	0.18	
Dayville	99	43	70.6	0.17	
Ella				0.10	
Eugene	96	46	67.5	0.36	
Fairview	85	42	60.9	T.	
Falls City	99	42	66.0	0.30	
Gardiner	85	45	60.5	0.20	
Glenora	102	39	65.8	0.12	
Government Camp	91	40	64.6	0.48	
Grants Pass	106	40	71.2	0.89	
Hare	86	45	59.6	3.00	
Harris	100	45	67.7	0.07	
Hood River (near)	103	45	70.2	0.27	
Huntington	106	50	81.8	0.29	
Jacksonville	106	45	73.0	0.70	
Joseph	94	36	65.6	0.40	
Junction City *5	110	50	71.9		
Kerby	105	37	70.0	0.51	
Klamath Falls	99	39	70.0		
Lafayette *1 f	85	45	61.0	0.00	
Lagrande	101	45	73.0	0.15	
Lakeview	101	40	70.6	0.27	
Lonerock	96	41	68.6	0.28	
McMinnville	101	41	67.6	0.88	
Merlin *1	104	42	72.0	0.28	
Monroe	98	45	68.0	0.50	
Mount Angel	99	49	69.2	0.55	
Nehalem				0.02	
Newbridge	100	41	71.8	0.51	
Newport	67	42	54.9	0.31	
Pendleton	109	45	76.1	0.09	
Placer				0.43	
Prineville	98	36	71.6	T.	
Riddles *1	102	42	67.8	1.29	
Riverside	105	37	73.0	0.34	
Salem *b*	98[1]	48[1]	67.2[1]	0.30	
Shaniko	94	44	68.6	0.30	
Sheridan *1	102	55	68.7	0.25	
Silverton *1	103	54	68.6	0.71	
Siskiyou *1	99	47	70.4	1.27	
Sparta	96	40	69.5	1.15	
Springfield *1	95	53	70.0	0.23	
Oregon—Cont'd.	°	°	°	*Ins.*	*Ins.*
Stafford	102	42	69.8	0.26	
The Dalles	102	48	73.6	0.16	
Tillamook				0.06	
Toledo	85	40	58.8	0.11	
Umatilla				0.15	
Vale	104	36	72.0	0.46	
Weston	101	42	71.4	T.	
Williams	100	38	67.4	0.03	
Pennsylvania.					
Aleppo	91	48	73.2	3.40	
Altoona	96	53	73.2	5.34	
Athens	90	46	70.1	4.79	
Beaver Dam				4.34	
Bellefonte	89	51	72.8	11.25	
Bethlehem				6.85	
Brookville				8.61	
Browers Lock				6.50	
Butler	91	46	71.0	9.12	
Cassandra	86	48	69.0	5.42	
Centerhall	89	46	70.6	11.30	
Coatesville	93	55	75.3	8.49	
Confluence	94	48	72.4	4.07	
Davis Island Dam				6.12	
Drifton	88g	54g	69.4g	8.99h	
Driftwood				7.53	
Duncannon				6.58	
Dushore	90	42	68.0	10.59	
Dyberry		43		5.65	
East Bloomsburg				11.03	
East Mauch Chunk	90	50	72.0	10.88	
Easton	90	56	74.2	6.96	
Ellwood Junction				7.06	
Emporium	86	47	69.4	6.29	
Ephrata	93	55	75.0	6.12	
Everett				10.35	
Forks of Neshaminy *1	88d	60c	73.3d	8.37	
Franklin	92	45	69.8	7.30	
Freeport				7.87	
Girardville				12.05	
Grampian	88	44	69.5	4.22	
Greensboro				3.66	
Hamburg				13.65	
Hamilnton	87	49	67.6	6.15	
Hawthorn	99	45	72.8	5.31	
Herrs Island Dam				3.87	
Huntingdon *a*	96	50	73.6	5.50	
Huntingdon *b*				5.63	
Irwin				3.25	
Johnstown	96	49	74.7	3.94	
Keating				6.08	
Kennett Square	90	56	74.8	9.23	
Lawrenceville	88			5.08	
Lebanon	90	53	73.7	8.66	
Leroy	87	50	69.3	5.40	
Lewisburg	90	51	72.6	10.60	
Lockhaven *a*	93	51c	74.6	7.50	
Lockhaven *b*				6.54	
Lock No. 4				2.48	
Lycippus	91c	53	72.8c	3.19	
Mifflin				3.85	
Oil City				4.11	
Parker				7.88	
Philadelphia	92	62	76.4	10.39	
Pottstown	90	64	77.0	5.64	
Quakertown	91	51	73.6	6.24	
Reading[2]			73.9	5.92	
Renovo *a*				7.30	
Renovo *b*	87c	51c	71.3c	7.99	
Saegerstown	90	42	68.6	7.15	
St. Marys	87	45	67.9	5.25	
Selinsgrove	89	54	73.0	8.50	
Shawmont				8.53	
Shinglehouse	89	44	68.5	5.47	
Smethport	88	43	67.6	5.64	
Somerset	88	48	67.0	4.98	
South Bethlehem	88	58	72.6	8.75	
South Eaton	87	52	70.2	5.76	
State College	88	52	71.1	8.97	
Sunbury				8.70	
Swarthmore	86	58	74.3	8.72	
Towanda	88	47	69.8	4.79	
Troutrun				6.99	
Uniontown	90	55	73.8	3.68	
Warren	85	48	68.7	8.82	
Wellsboro	87	46	69.0	5.04	
Westchester	88	60	74.9	8.52	
West Newton				3.56	
Wilkesbarre	93	50	72.2	7.23	
Williamsport	88	58	73.1	5.18	
York	95	56	75.8	6.27	
Rhode Island.					
Bristol	82	59	71.7	2.56	
Kingston	87	54	69.4	1.98	
Pawtucket	89	54	73.2	2.40	
Providence *a*	91	60	74.6	2.56	
Providence *c*	88	56	71.4	2.66	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
South Carolina.					
Allendale	97	61	80.6	6.75	
Anderson	95	65	77.9	17.35	
Batesburg	96	66	79.9	6.62	
Beaufort	91	69	80.5	3.23	
Blackville	99	66	80.8	4.33	
Calhoun Falls				13.48	
Camden				9.75	
Cheraw *a*	95	64	78.5	12.25	
Cheraw *b*				12.15	
Clemson College	94	57	76.0	13.17	
Conway				5.59	
Darlington				5.81	
Edisto				5.20	
Effingham				6.72	
Florence	96	67	80.6	9.96	
Gaffney				16.26	
Georgetown	91	68	80.3	7.40	
Gillisonville	95	65	80.0	7.90	
Greenville	89	62	74.2	15.72	
Greenwood	97	65	78.9	8.61	
Kingstree *a*	93	65	77.8	4.28	
Kingstree *b*				3.85	
Liberty	92	57	76.8	13.32	
Little Mountain	96	65	79.1	9.75	
Longshore	95	64	78.9	12.08	
Pinopolis *[1]	88	68	77.5	3.61	
St. Georges	94	62	79.3	7.61	
St. Matthews	90	65	79.6	5.60	
St. Stephens				7.94	
Santuck	96	61	77.7	12.28	
Smiths Mills				8.47	
Society Hill	91	67	79.7	5.50	
Spartanburg	96	63	77.6	15.66	
Statesburg	91	67	79.6	5.17	
Summerville	87	66	77.4	7.78	
Temperance	94	66	78.8	9.42	
Trenton	89	69	79.2	8.01	
Trial	90	68	76.6	3.89	
Walhalla	89	61	74.2	17.63	
Winnsboro	95	65	78.8	9.16	
Winthrop College	91	64	75.1	10.60	
Yemassee	95	67	81.0	5.11	
Yorkville	93	65	78.8	12.75	
South Dakota.					
Aberdeen	103	47	71.2	3.16	
Academy	110	47	73.8	4.67	
Alexandria	107	50	73.6	2.13	
Armour	107	50	74.6	4.86	
Ashcroft	104	41	69.4	1.23	
Bad Nation *	100	42	73.3	2.51	
Bowdle	97	45	70.2	1.91	
Brookings	101	46	70.4	2.94	
Canton	106	45	73.8	1.93	
Centerville				2.84	
Chamberlain	109	51	74.4	4.82	
Clark	101	42	70.4	2.16	
Desmet	106	48	70.8	2.53	
Doland	108	45	71.6	3.13	
Elkpoint	101	49	75.4	2.10	
Farmingdale				2.20	
Faulkton	101	42	71.4	2.57	
Flandreau	100	48	71.2	4.27	
Forestburg	112	47	74.4	1.79	
Fort Meade	95	48	71.2	2.75	
Gannvalley	110	50	74.8	2.33	
Gary	96	50	71.1	1.75	
Grand River School	102	42	72.7	2.87	
Greenwood	98[i]	56[i]	77.2[i]	3.73	
Hartman	101	50	72.7	1.87	
Highmore				2.34	
Hitchcock				2.73	
Hotch City	108			2.86	
Howard	103	41	70.0	2.08	
Ipswich	103	47	72.8	1.93	
Kimball	107[h]	54	72.8[f]	4.00	
Leola	97	38	70.2	0.59	
Leslie	107	40	75.6	1.78	
Marion	101	51	73.8	2.29	
Mellette		40		1.15	
Menno	105	49	73.8	2.45	
Millbank	105	41	70.8	0.99	
Mitchell	109	52	73.4	1.95	
Mound City	99	45	70.8	1.83	
Oelrichs	99	50	73.4	0.30	
Pine Ridge	102	47	73.8	0.80	
Plankinton	108	49	72.8	2.17	
Redfield	106	39	71.0	2.89	
Rochford	91	37	63.0	2.63	
Ro-ebud	98	49	73.8	2.75	
St. Lawrence	110	40	71.9	3.75	
Silver City				3.18	
Sioux Falls	101	51	73.4	2.02	
Sisseton Agency	99	45	70.5	1.12	
Spearfish	93	49	69.8	2.06	
Vermillion	105	52	76.0	2.40	
Waubay	97	42	67.2	2.89	

Stations	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
South Dakota—Cont'd.	°	°	°	Ins.	Ins.
Wentworth	100	40	71.8	2.35	
Wessington Springs	95	48	69.4	2.69	
Wolsey				3.21	
Tennessee.					
Andersonville	97	53	73.1	15.98	
Arlington	102	57	78.9	5.01	
Ashwood	101	54	76.0	5.15	
Benton	96	53	75.4	11.21	
Bluff City				9.40	
Bolivar	103	60	77.4	8.37	
Bristol	87	54	72.0	8.55	
Brownsville	103	59	77.2	5.25	
Byrdstown	92	54	72.7	15.55	
Carthage	100	62	76.4	12.59	
Clarksville	99	61	76.6	5.50	
Clinton				13.23	
Covington	101	57	78.3	7.94	
Decatur	100	53	75.6	16.72	
Dickson	97	61[j]	77.4[e]	9.85	
Dover	97[h]	56[h]	76.8[h]	6.00	
Dyersburg	103	51	79.0	4.40	
Elizabethton	90	53	71.8	12.14	
Elk Valley	93	50	72.4	10.42	
Erasmus	95	45	70.2	12.73	
Florence	96	59	75.2	9.33	
Franklin	97	57	74.8	9.80	
Grace *[1]	98	60	79.0	11.80	
Greeneville	93	53	72.3	14.07	
Harriman	95	56	74.6	11.31	
Hohenwald	99	55	75.0	10.74	
Iron City	104	56	75.8	12.16	
Johnsonville	100	55	77.3	10.74	
Jonesboro *[1]	87	63	71.0	8.33	
Kingston				11.62	
Lewisburg	100	58	76.5	9.94	
Liberty	99	55	75.2	7.91	
Lynnville	99	58	74.8	11.64	
McMinnville	99	59	74.8	15.77	
Maryville	99	55	76.0	9.63	
Milan	103	60	77.8	11.54	
Newport	92	58	74.2	10.83	
Nunnelly	100	54	76.6	10.68	
Oakhill	91	52	72.8	9.24	
Palmetto	99	59	76.4	9.46	
Peryear *[b]	96	64	77.2	6.21	
Pope	104	54	77.6	10.00	
Rogersville	88	57	72.2	10.21	
Rugby	96	52	71.8	11.68	
Savannah	101	61	78.0	8.83	
Sewanee	96	60	71.6	13.36	
Silverlake	83	48	67.9	16.54	
Springdale	95	52	73.4	13.18	
Springfield		60		6.85	
Tazewell				11.05	
Tellico Plains	96	54	75.0	12.37	
Tracy City	95	51	71.6	13.66	
Trenton	100	60	79.2	10.52	
Tullahoma	97	53	73.6	13.40	
Union City	98	60	77.5	3.10	
Waynesboro	99	57	75.2	9.82	
Wildersville	96	62	76.2	9.08	
Yukon	99	62	75.1	9.96	
Texas.					
Alvin				0.99	
Anna				1.47	
Arthur				3.52	
Austin *a*	103	60	83.0	1.80	
Austin *b* *[5]	104	69	85.8		
Ballinger	107	65	85.2	0.63	
Beaumont	103	70	85.6	3.68	
Beeville	104	64	83.6	1.52	
Big Spring				0.11	
Blanco	102	64	83.6	1.01	
Boerne *[1]	101	70	83.7	1.18	
Booth				4.44	
Bowie	109	64	85.2	1.02	
Brazoria	96	72	83.0	1.09	
Brenham	103	71	86.5	0.76	
Brighton	98	72	84.1	1.31	
Burnet	108	68	85.8	0.68	
Camp Eagle Pass	109	70	88.4	0.42	
College Station	108	61	83.6		
Columbia	97	68	82.2	1.80	
Comanche	106	62	85.4	0.01	
Corsicana	104	67	85.6	1.01	
Cotulla	110	71	90.2	T.	
Cuero	104	73	88.6	1.20	
Dallas	105	65	84.8	2.77	
Danevang	98	70	83.8	1.84	
Dublin	105	65	84.6	1.03	
Duval	104	69	86.1	2.76	
Estelle	107	67	86.1	1.20	
Fort Brown	101			1.00	
Fort Clark	104	68	86.8	0.88	
Fort McIntosh	106	71	90.0	0.00	
Fort Ringgold	108	82	92.8	0.54	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Texas—Cont'd	°	°	°	Ins.	Ins.
Fort Stockton				0.67	
Fredericksburg	102	65	84.2	1.50	
Gainesville	106	63	82.6	1.18	
Grapevine	108	67	87.2	0.46	
Hale Center	99	64	78.2	1.75	
Hallettsville	104	72	86.0	1.96	
Haskell	115	68	87.6	0.55	
Hearne	104	71	87.3	0.21	
Henrietta	110	66	85.7	1.46	
Hewitt				1.18	
Hondo				0.05	
Houston	98	72	84.5	2.14	
Huntsville	102	68	85.4	1.11	
Ira	106	61	83.8	T.	
Jacksonville	101[b]	65[c]	82.4[c]	2.11	
Jasper	98	69	85.2	4.08	
Junction				0.33	
Kent				1.37	
Kerrville	99	60	78.8	1.53	
Kopperl				1.05	
Lampasas	105	64	86.2	0.53	
Laureles Ranch				1.00	
Llano *[b]	105	74	89.4	T.	
Longview	104	69	85.1	1.47	
Luling	104	71	86.9	0.31	
Mann	106[d]	67[d]	87.0[d]	0.84	
Menardville	105	62	82.1	2.49	
Mount Blanco				1.05	
Nacogdoches	102	66	83.0	2.18	
New Braunfelds	102	67	84.2	0.86	
Panter				1.61	
Paris *a*	101	60	82.1	4.13	
Port Lavaca	99	74	83.8	0.20	
Rhineland	111	66	86.4	0.76	
Rockisland	102	67	84.8	2.40	
Runge	106	69	86.8	0.82	
Sanderson	102	70	85.9	0.72	
San Marcos	104	65	85.0	1.02	
San Saba	107	63	86.1	1.46	
Sulphur Springs	99	69	82.2	8.08	
Temple *a*	104	69	87.1	0.25	
Temple *b*	106	68	86.3	0.50	
Trinity	101	69	85.1	3.08	
Tulia				4.70	
Tyler	103	69	84.4	2.45	
Victoria				2.23	
Waco	105	70	87.8	0.65	
Waxahachie	107	66	85.9	3.50	
Weatherford	108	65	86.0	0.83	
Wichita Falls				0.10	
Utah.					
Alpine				2.20	
Aneth	104	53	79.7	1.46	
Blackrock	92	46	70.9	1.02	
Bluecreek				0.70	
Castledale	95	42	67.6	1.83	
Cisco	103	56	76.6	0.66	
Corinne	101	44	76.5	3.75	
Coyoto[b]	92	40	66.0	1.70	
Deseret	98	47	72.6	1.54	
Emery	95	47	70.0	1.48	
Farmington	99	52	75.1	0.91	
Fillmore	101	49	76.9	0.90	
Fish Springs	111	56	79.1	T.	
Fort Duchesne	99	36	69.2	2.47	
Frisco	96	49	72.0	0.64	
Giles	103	51	77.1	1.56	
Government Creek	95	44	72.4	3.35	
Green River	107	54	81.4	0.97	
Grover	91	49	68.6	1.89	
Heber	95	34	66.9	2.06	
Henefer	92	35	67.0	2.08	
Hite	108	62	86.1	0.35	
Huntsville				1.09	
Kelton *[1]	107	62	79.2	T.	
Lasal	91	45	70.2	2.55	
Levan	98	46	71.6	1.55	
Loa		31		3.76	
Logan	92	54	72.8	1.60	
Lund				0.28	
Manti	93	43	70.2	1.23	
Marysvale	92	44	69.0	1.94	
Meadowville	89	42	66.4	0.95	
Millville				2.47	
Minersville	93	52	73.1	1.60	
Moab	100	52	77.0	1.47	
Mount Pleasant	96	46	71.6	1.64	
Ogden *[1]	95	61	77.3	2.65	
Park City	92	46	68.0	1.40	
Parowan	94	47	70.9	3.35	
Pinto	93[f]	39	67.4[d]	5.07	
Promontory				0.30	
Provo	96	48	73.8		
Richfield	96	42	69.8	0.03	
St. George	108	52	79.8	1.70	
Scipio	97	41	71.6	2.67	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Utah—Cont'd.	°	°	°	*Ins.*	*Ins.*
Snowville	98	40	70.6	1.15	
Soldier Summit	93	36	65.0	1.68	
Terrace	.....	.....	.....	0.95	
Thistle	102	43	72.6	3.05	
Tooele	95	49	75.1	0.82	
Tropic	90	36	63.3	1.72	
Vernal	99	46	73.2	0.73	
Wellington	99	41	71.2	0.99	
Woodruff	88	36	63.3	.....	
Vermont.					
Burlington	84	57	70.8	3.18	
Chelsea	82	42	65.4	1.57	
Cornwall	84	50	69.1	3.27	
Enosburg Falls	85	42	66.4	5.74	
Hartland	84	44	66.4	3.58	
Jacksonville	83	40	65.3	3.82	
Manchester	88	51	67.4	4.95	
Norwich	86	44	66.9	3.30	
St. Johnsbury	87	43	67.8	4.44	
Vernon *[6]	82	60	69.8	5.74	
Wells	84	51	67.9	3.90	
Woodstock	90	34	63.0	2.32	
Virginia.					
Alexandria	98	61	77.4	4.13	
Ashland	95	60	76.8	10.13	
Barboursville	90	60	75.0	9.00	
Bedford	94	58	75.9	15.17	
Bigstone Gap	90	53	72.1	10.60	
Birdsnest[2]	.....	.....	75.7	3.45	
Blacksburg	87	45	68.6	10.53	
Bon Air	91	61	76.0	9.66	
Buckingham	93	54	74.9	13.75	
Burkes Garden	83	43	66.4	9.11	
Callaville	92	60	77.8	7.52	
Charlottesville	89	59	74.1	12.91	
Clarksville	.....	.....	.....	8.65	
Clifton Forge	88	56	69.6	5.24	
Columbia	95	60	76.7	8.60	
Dale Enterprise	89	50	70.6	6.36	
Danville	.....	.....	.....	9.62	
Doswell	94	57	76.7	9.11	
Fontella	92	59	75.2	11.70	
Fredericksburg	92	63	76.6	8.23	
Grahams Forge	88	53	71.0	17.58	
Hampton	90	66	78.4	7.69	
Hot Springs	86	47	68.4	6.22	
Lincoln	92	56	74.8	3.73	
Manassas	98	51	73.8	4.81	
Marion	89	49	71.2	10.82	
Newport News	95	69	81.6	11.19	
Petersburg	91	62	77.0	7.13	
Quantico	93[h]	58[h]	76.1[h]	.....	
Radford	.....	.....	.....	11.76	
Salem	.....	.....	.....	10.90	
Speers Ferry	.....	.....	.....	10.32	
Spottsville	94	60	77.5	8.32	
Stanardsville	91	48	72.8	8.90	
Staunton	90	55	73.0	6.71	
Stephens City	98	55	76.4	3.68	
Warsaw	92	60	76.7	7.25	
Westpoint	90	62	77.0	6.80	
Williamsburg	90	63	76.3	9.00	
Woodstock	95	52	75.4	6.92	
Wytheville	89	49	71.4	13.15	
Washington.					
Aberdeen	86	41	59.6	0.35	
Anacortes	.....	.....	.....	T.	
Ashford	.....	.....	.....	0.67	
Bremerton	93	45	64.8	0.32	
Brinnon	83	47	63.7	0.21	
Buchanan's Farm	.....	.....	.....	0.17	
Cedonia	93	46	68.6	T.	
Centerville	104	44	73.0	0.22	
Cheney	.....	.....	.....	0.00	
Clearwater	87	44	62.5	0.30	
Cle Elum	101	38	67.0	0.04	
Colfax	104	39	70.3	0.16	
Colville	100	39	67.0	0.08	
Conconully	95	45	68.6	0.27	
Connell	.....	.....	.....	0.05	
Coupeville	87	44	62.0	T.	
Crescent	99	44	69.8	0.08	
Dayton	105[e]	41[e]	72.4[e]	0.40	
East Sound	86	40	61.0	T.	
Ellensburg	93	42	68.8	0.03	
Ellensburg (near)	102	44	71.4	0.02	
Grandmound	93	44	64.8	0.22	
Granite Falls	.....	.....	.....	0.04	
Hooper	111	46	74.8	0.09	
Ilwaco	83	47	60.6	0.00	
Issaquah	.....	.....	.....	0.09	
Lacenter	99	46	68.3	0.02	
Lakeside	95	54	75.5	0.02	
Lind	108	45	78.0	0.04	
Mayfield	93	44	65.4	0.50	
Monte Cristo	97	43	65.0	0.17	
Washington—Cont'd.	°	°	°	*Ins.*	*Ins.*
Mottinger Ranch	108	52	78.6	0.13	
Mount Pleasant	101	46	68.1	0.25	
Moxee Valley	103	45	73.2	0.11	
Olga	80	46	60.4	T.	
Olympia	96	42	64.3	0.12	
Pasco	111	50	80.2	T.	
Pinehill	104	46	72.8	0.23	
Pomeroy	108	46	74.7	0.18	
Port Townsend	85	46[d]	61.8	0.02	
Renton	.....	.....	.....	0.20	
Republic	97	41	66.3	0.09	
Ritzville	.....	.....	.....	0.00	
Rosalia	97	41	68.9	0.37	
Sedro	89	40	66.0	0.01	
Silvana	86	42	62.3	0.00	
Snohomish	84	44	63.4	T.	
Snoqualmie	91	38	61.2	0.15	
Southbend	96	41	61.9	T.	
Sprague	.....	.....	.....	0.00	
Sunnyside	100	45	74.0	0.10	
Twin	84	41	56.4	0.05	
Union	95	45	65.2	0.21	
Usk	98	37	66.5	0.36	
Vancouver	94	46	66.3	0.18	
Waterville	100	45	72.0	0.00	
Wenatchee (near)	97	48	72.5	0.03	
Whatcom	77	43	59.9	T.	
Wilbur	102	37	69.4	0.04	
West Virginia.					
Beckley	84	50	68.4	2.71	
Belleville[d]	91	56	74.6	.....	
Beverly	94	50	71.0	6.12	
Bluefield	88[e]	50	70.3[e]	9.92	
Burlington	91	52	72.9	6.99	
Byrne	94	54	75.8	5.10	
Camden	88	53	72.5	5.53	
Central	94	51	72.9	3.91	
Chapel	93	58	78.1	5.50	
Charleston	.....	.....	.....	5.00	
Clay	96	55	75.5	8.43	
Creston	96[j]	55	76.1[e]	3.80	
Dayton	93	50	72.0	4.56	
Elkhorn	87	52	71.6	5.98	
Fairmont	.....	.....	.....	2.92	
Glenville	95	53	74.6	5.34	
Grafton	92	51	72.1	5.30	
Green Sulphur	87	56	70.6	5.94	
Harpers Ferry	.....	.....	.....	5.00	
Hinton *a*	.....	.....	.....	8.54	
Hinton *b*	87	58	72.0	8.54	
Huntington	96	56	75.3	2.88	
Josiah	94	58	74.8	2.49	
Lewisburg	87	59	70.0	8.50	
Magnolia	95	52	74.0	5.72	
Mannington	94	52	74.4	3.93	
Marlinton	85	47	68.3	8.03	
Martinsburg	92	50	73.5	7.37	
Morgantown	91	55	72.8	7.37	
Moscow	92	50	72.0	5.60	
New Martinsville	97	55	76.8	2.49	
Nuttallburg	89	52	70.6	4.54	
Oceana	89	56	73.2	6.59	
Oldfields	97	54	74.2	6.86	
Parsons	89	54	71.4	5.10	
Philippi *a*	91	43	69.2	3.33	
Point Pleasant	95	50	75.8	1.64	
Powellton	92	55	74.0	3.18	
Princeton	84	53	69.2	13.70	
Romney	94	52	74.8	6.76	
Rowlesburg	.....	.....	.....	4.31	
Southside	94	60	75.6	3.17	
Spencer	93	52	74.4	3.88	
Uppertract	90	50	72.0	6.19	
Wellsburg	89	52	72.0	4.16	
Weston *a*	.....	.....	.....	4.86	
Weston *b*	92	53	74.6	.....	
Wheeling *a*	.....	.....	.....	5.09	
Wheeling *b*	98	60	79.4	3.80	
Williamson	92	60	74.9	5.33	
Winfield	91	57	73.9	3.26	
Wisconsin.					
Antigo	88	42	65.9	3.13	
Appleton	85	49	69.4	1.18	
Ashland	.....	.....	.....	2.33	
Barron	90	34	66.6	1.70	
Beloit	92	53	71.5	0.76	
Brodhead	94	51	72.3	0.46	
Butternut	84	35	62.6	5.29	
Chilton	90	46	69.4	0.96	
Citypoint	93	45	70.8	1.36	
Darlington	91	45	69.0	0.25	
Dodgeville	93	42	70.2	0.62	
Easton	90	44	69.9	1.87	
Eau Claire	93	47	71.6	2.06	
Florence	84	41[i]	63.3[e]	3.15	
Fond du Lac	88	45	69.8	1.46	
Wisconsin—Cont'd.	°	°	°	*Ins.*	*Ins.*
Grand River Locks	.....	.....	.....	1.60	
Grantsburg	94	39	68.6	2.13	
Hartland	91	48	70.5	1.84	
Harvey	95	51	71.4	1.02	
Hayward	92	41	66.8	4.40	
Hillsboro	93	40	69.0	0.81	
Knapp	91	44	68.8	1.31	
Koepenick	90	38	64.0	3.80	
Ladysmith	90	39	67.6	1.07	
Lancaster	93	49	72.6	0.64	
Madison	88	54	71.6	1.33	
Manitowoc	90	48	69.0	1.42	
Meadow Valley	94	39	68.9	1.84	
Medford	100	38	67.4	1.80	
Menasha	.....	.....	.....	0.77	
Neillsville	90	40	68.9	1.75	
New Holstein	92	44	69.4	1.84	
New London	91	46	69.1	1.10	
North Crandon	84	38	63.2	2.45	
Oconto	90	45	71.1	2.59	
Osceola	94	37	68.4	2.35	
Pepin	94	48	72.8	0.90	
Pine River	90	45	69.2	1.65	
Port Washington	88	46	67.8	2.27	
Prairie du Chien *a*	96	51	74.3	1.14	
Prairie du Chien *b*	.....	.....	.....	1.27	
Prentice	90	40	65.8	2.80	
Racine	94	52	71.2	1.41	
Shawano	89	41	67.6	1.71	
Sheboygan	88	51	69.6	1.40	
Stevens Point	91	45	68.6	1.44	
Valley Junction[h]	91	40	68.6	1.58	
Viroqua	93	45	70.2	1.52	
Watertown	90	46	69.0	1.50	
Waukesha	90	53	71.0	0.77	
Waupaca	89	45	69.3	1.64	
Wausau	.....	.....	.....	2.10	
Wausaukee	88	42	67.0	2.57	
Westbend	95[e]	47[i]	71.7[e]	0.73	
Westfield	88	48	69.7	1.40	
Whitehall	91	41	69.6	1.64	
Wyoming.					
Alcova	101	45	73.2	0.35	
Basin	.....	.....	.....	0.83	
Bedford	91	34	63.7	1.71	
Bitter Creek	102	30	64.6	0.53	
Buffalo	96	46	69.2	1.33	
Casper	96	46	71.7	0.46	
Centennial	88	41	60.4	3.06	
Chugwater	90	42	66.9	0.73	
Embar	102	36	70.1	0.92	
Evanston	88	38	62.9	1.00	
Fort Laramie	99	49	72.8	0.57	
Fort Washakie	99	44	67.2	0.59	
Fort Yellowstone	88	39	63.0	1.65	
Fourbear	83	35	61.3	2.02	
Griggs	95	45	69.2	0.90	
Hyattville	95	46	70.8	0.09	
Iron Mountain	90	41	65.8	1.16	
Laramie	86	41	62.6	1.11	
Leo	91	39	66.1	T.	
Lusk	92	46	69.1	0.95	
Moore	92	32	61.6	0.69	
Myersville	94	30	63.5	T.	
Parkman	94	44	69.4	1.33	
Pinebluff	99	45	70.2	1.88	
Rawlins	92	41	66.1	0.55	
Saratoga	95	41	66.3	1.05	
Sheridan	95	42	69.0	1.55	
South Pass City	88	29	61.2	0.60	
Springhill	80	28	53.0	0.00	
Thayne	88	33	62.5	1.02	
Thermopolis	99	46	72.4	0.46	
Wheatland	95	53	72.8	0.36	
Cuba.					
Aguacate	96	68	85.3	9.04	
Australia	94	70	81.5	3.28	
Banaguises	92	68	80.0	4.50	
Batabano	97	68	82.7	2.55	
Camajuani	91	65	78.0	5.15	
Ciego de Avila	.....	.....	.....	6.06	
Cruces	.....	.....	.....	7.52	
Gibara	95	68	81.8	2.08	
Guabairo	.....	.....	.....	7.37	
Guanajay	90	64	78.4	10.96	
Guantanamo	95	68	81.1	3.56	
Guines	94	67	81.6	5.71	
Holguin	97	69	83.0	0.87	
Isabel, Guantanamo	.....	.....	.....	4.73	
Los Canos	97	62	80.5	3.38	
Magdalena	.....	.....	.....	3.29	
Manzanillo	95	70	84.6	5.04	
Moron Trocha	96	66	81.7	6.75	
Nuevitas	100	72	88.6	0.45	
Pinar del Rio	92	71	81.4	11.54	
Romelie, Guantanamo	.....	.....	.....	3.43	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Cuba—Cont'd.	°	°	°	*Ins.*	*Ins.*
San Cayetano	94	69	81.4	2.35	
Sancti Spiritus	90	70	79.0	5.31	
Santa Clara	93	60	79.0	7.08	
Santa Cruz del Sur	92	71	80.6	4.64	
Soledad	91	67	79.2	7.25	
Soledad, Guantanamo	95	66	80.0	1.85	
Union de Reyes	93	72	81.2	6.14	
Yaguajay	96	70	81.8	4.97	
Yateras	......	......	......	6.20	
Porto Rico.					
Aguirre	92	70	82.0	4.26	
Arecibo	89	68	79.2	2.72	
Barros	......	...	...	4.40	
Bayamon	97[e]	68	81.1[e]	9.42	
Canovanas	90	72	81.3	6.63	
Cayey	97	66	80.8	5.61	
Cidra	93[h]	64[h]	79.2[h]	8.39	
Coamo	96	67	81.7	4.12	
Corozal	92	64	79.0	8.51	
Fajardo	93	72	83.2	2.90	
Guayama	......	......	......	5.82	
Hacienda Amistad	94	63	79.4	6.08	
Hacienda Coloso	95	66	79.5	6.32	
Hacienda Perla	90	71	80.6	7.80	
Humacao	90	66	77.6	10.70	
Isabela	93	72	81.9	2.53	
La Isolina	91	65	77.8	5.64	
Las Marias	94	67	80.0	16.70	
Manati	97	67	81.3	3.60	
Maunabo	92	74	85.4	6.37	
Mayaguez	94	68	80.8	9.86	
Morovis	93	65	79.3	6.93	
Ponce	97	64	81.0	2.47	
San Lorenzo	91	67	79.4	7.27	
San Salvador	90	65	77.0	6.24	
Santa Isabel	95	70	82.0	2.96	
Utuado	......	65	......	7.04	
Vieques	89	77	82.8	6.80	
Yauco	91	69	80.4	4.30	
Mexico.					
Ciudad P. Diaz	105	74	88.8	0.11	
Leon de Aldamas	85	53	69.8	3.28	
Puebla	76	54	65.3	8.85	
New Brunswick.					
St. John	77	51	63.3	1.10	
Nicaragua.					
Rivas	90	74	82.3	9.40	
Isthmus of Panama.					
Alhajuela	90	68	77.4	17.85	
La Boca	90	75	81.3	5.39	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Late reports for July, 1901.					
Alaska.	°	°	°	*Ins.*	*Ins.*
Coal Harbor	69	38	51.9	1.64	
Fort Liscum	73	32	50.6	4.77	
Juneau	79	40	58.2	1.98	
Kenai	80	30	52.8	1.66	
Killisnoo	71	43	57.6	1.40	
Orca	79	33	55.2	3.62	
Tyoonok	......	38		2.68	
Wood Island	79	42	55.3	3.56	
Arizona.					
Bowie*[1]	110	50	81.2	3.79	
Dudleyville	109	61	85.6	1.91	
Arkansas.					
New Gascony	106	55	84.1	0.89	
California.					
Caliente*[1]	112	79	91.8	0.00	
Cisco*[1]	84	40	62.2	0.00	
San Miguel Island	76	47	59.7	0.00	
Colorado.					
Rangely	98	37	69.6	T.	
Ruby	......	......	......	0.08	
Whitepine	......	......	......	1.38	
Georgia.					
Louisville[b]	101	70	81.8	4.11	
Idaho.					
Paris	97	32	66.9	0.18	
Illinois.					
Dwight	103	48	81.2	2.00	
Kentucky.					
Carrollton	103	58	84.2	0.40	
Maryland.					
College Park	102	61	79.0	5.74	
Michigan.					
St. Johns	96	54	76.6	4.80	
Minnesota.					
Campbell	99	52	74.2	5.81	
Winnebago City	105	49	79.5	2.19	
New Mexico.					
Las Lunas	101	55	78.6	3.35	
North Dakota.					
Bottineau	92	47	68.3	3.77	
Rhode Island.					
Providence *c*	95	54	74.4	3.46	
Texas.					
Fort McIntosh	102	70	86.3	0.00	
Virginia.					
Doswell	104	57	81.0	4.99	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Porto Rico.	°	°	°	*Ins.*	*Ins.*
Vieques	89	72	81.1	11.80	
Nicaragua.					
Rivas	89	74	80.7	13.80	

EXPLANATION OF SIGNS.

* Extremes of temperature from observed readings o dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.
[7] Mean from hourly readings of thermograph.
[9] Mean of sunrise and noon.
[10] Mean of sunrise, noon, sunset, and midnight.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance "n" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.

CORRECTIONS.

July, 1901, Boettcherville, Md., make total precipitation 3.08 instead of 4.08; Morovis, Porto Rico, cut out all values and enter 92, 64, 78.2, 17.92.

June, 1901, in table of late reports for May, 1901, make mean temperature at Amenia, N. Dak., read 59.2 instead of 64.2.

TABLE III.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of August, 1901.*

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	14	27	9	30	s. 59 w.	25
Portland, Me	15	30	12	19	s. 25 w.	17
Northfield, Vt	15	43	5	2	s. 6 e.	28
Boston, Mass	9	27	19	21	s. 6 w.	18
Nantucket, Mass	15	29	21	15	s. 23 e.	15
Block Island, R. I	10	24	25	19	s. 23 e.	15
New Haven, Conn	20	25	12	14	s. 22 w.	5
Middle Atlantic States.						
Albany, N. Y	18	29	8	12	s. 20 w.	12
Binghamton, N. Y†	8	6	20	6	n. 82 e.	14
New York, N. Y	15	24	22	16	s. 34 e	11
Harrisburg, Pa†	9	9	13	5	e.	8
Philadelphia, Pa	12	23	28	11	s. 57 e.	20
Scranton, Pa	20	18	23	14	n. 77 e.	9
Atlantic City, N. J	10	29	21	17	s. 12 e.	19
Cape May, N. J	14	32	22	8	s. 38 e.	23
Baltimore, Md	15	24	23	10	s. 55 e.	16
Washington, D. C	19	29	18	9	s. 42 e.	14
Lynchburg, Va	11	21	27	16	s. 48 e.	15
Norfolk, Va	13	34	14	13	s. 3 e.	21
Richmond, Va	17	31	16	10	s. 23 e.	15
South Atlantic States.						
Charlotte, N. C	11	30	23	10	s. 34 e.	23
Hatteras, N. C	15	34	15	15	s.	19
Raleigh, N. C	14	32	15	17	s. 6 w.	18
Wilmington, N. C	5	41	16	12	s. 6 e.	36
Charleston, S. C	10	38	15	9	s. 12 e.	29
Columbia, S. C	9	35	28	6	s. 40 e.	34
Augusta, Ga	8	29	25	9	s. 37 e.	26
Savannah, Ga	8	38	12	16	s. 8 w.	30
Jacksonville, Fla	9	31	26	13	s. 30 e.	26
Florida Peninsula.						
Jupiter, Fla	7	29	30	14	s. 36 e.	27
Key West, Fla	12	23	34	7	s. 68 e.	29
Tampa, Fla	22	13	32	11	n. 67 e.	23
Eastern Gulf States.						
Atlanta, Ga	12	28	25	13	s. 37 e.	20
Macon, Ga†	7	15	12	3	s. 48 e.	12
Pensacola, Fla†	15	6	12	8	n. 24 e.	10
Mobile, Ala	19	25	15	21	s. 45 w.	8
Montgomery, Ala	8	26	29	11	s. 45 e.	26
Vicksburg, Miss	16	22	23	18	s. 40 e.	8
New Orleans, La	10	30	13	23	s. 27 e.	22
Western Gulf States.						
Shreveport, La	22	14	23	14	n. 48 e.	12
Fort Smith, Ark	22	18	23	10	n. 72 e.	13
Little Rock, Ark	16	22	18	22	s. 34 w.	7
Corpus Christi, Tex	6	39	23	12	s. 18 e.	35
Fort Worth, Tex	15	20	30	5	s. 79 e.	26
Galveston, Tex	9	38	15	12	s. 6 e.	29
Palestine, Tex	17	26	23	4	s. 63 e.	20
San Antonio, Tex	13	27	37	2	s. 68 e.	38
Ohio Valley and Tennessee.						
Chattanooga, Tenn	15	26	24	14	s. 42 e.	15
Knoxville, Tenn	24	18	18	16	n. 18 e.	6
Memphis, Tenn	21	20	19	15	n. 76 e.	4
Nashville, Tenn	19	21	22	16	s. 72 e.	6
Lexington, Ky†	5	12	14	3	s. 58 e.	13
Louisville, Ky	21	26	19	6	s. 69 e.	14
Evansville, Ind†	12	9	12	3	n. 72 e.	10
Indianapolis, Ind	31	17	14	11	n. 12 e.	14
Cincinnati, Ohio	16	24	27	8	s. 70 e.	20
Columbus, Ohio	16	23	28	7	s. 72 e.	22
Pittsburg, Pa	20	24	18	18	s.	4
Parkersburg, W. Va	20	27	19	10	s. 52 e.	11
Elkins, W. Va	22	21	13	17	n. 76 w.	4
Lower Lake Region.						
Buffalo, N. Y	17	22	17	17	s.	5
Oswego, N. Y	14	27	17	14	s. 13 e.	13
Rochester, N. Y	13	25	16	22	s. 27 w.	13
Erie, Pa	14	25	20	10	s. 42 e.	15
Cleveland, Ohio	22	21	29	6	n. 88 e.	23
Sandusky, Ohio	16	19	27	10	s. 80 e.	17
Toledo, Ohio	20	19	21	16	n. 79 e.	5
Detroit, Mich	20	20	23	11	e.	12
Upper Lake Region.						
Alpena, Mich	15	22	19	21	s. 16 w.	7
Escanaba, Mich	25	25	7	14	w.	7
Grand Haven, Mich	23	13	19	19	n.	10
Houghton, Mich.†	11	4	12	11	n. 8 e.	7
Marquette, Mich	20	16	13	26	n. 72 w.	13
Port Huron, Mich	22	17	23	16	n. 54 e.	9
Sault Ste. Marie, Mich	14	11	27	21	n. 63 e.	7
Chicago, Ill	27	14	34	5	n. 66 e.	32
Milwaukee, Wis	30	15	19	10	n. 31 e.	18
Green Bay, Wis	21	21	20	18	e.	2
Duluth, Minn	31	10	19	22	n. 8 w.	21
North Dakota.						
Moorhead, Minn	25	16	21	17	n. 24 e.	10
Bismarck, N. Dak	23	15	24	12	n. 56 e.	14
Williston, N. Dak	34	10	15	13	n. 5 e.	24
Upper Mississippi Valley.						
St. Paul, Minn	21	25	16	14	s. 27 e.	4
La Crosse, Wis.†	9	15	5	4	s. 9 e.	6
Davenport, Iowa	25	9	32	10	n. 54 e.	27
Des Moines, Iowa	23	16	32	6	n. 75 e.	27
Dubuque, Iowa	25	17	19	17	n. 14 e.	8
Keokuk, Iowa	29	12	28	8	n. 50 e.	26
Cairo, Ill	19	22	25	8	s. 80 e.	17
Springfield, Ill	24	12	31	7	n. 63 e.	27
Hannibal, Mo†	15	4	12	4	n. 36 e.	14
St. Louis, Mo	27	15	23	7	n. 53 e.	20
Missouri Valley.						
Columbia, Mo*	15	3	15	6	n. 37 e.	15
Kansas City, Mo	25	17	23	9	n. 60 e.	16
Springfield, Mo	22	19	26	11	n. 79 e.	15
Lincoln, Nebr	22	24	34	5	s. 86 e.	29
Omaha, Nebr	24	18	27	5	n. 75 e.	23
Valentine, Nebr	17	22	25	10	s. 72 e.	16
Sioux City, Iowa†	12	9	12	4	n. 69 e.	8
Pierre, S. Dak	16	25	26	12	s. 57 e.	17
Huron, S. Dak	20	25	20	14	s. 50 e.	8
Yankton, S. Dak†	12	4	10	10	n.	8
Northern Slope.						
Havre, Mont	19	17	22	22	n.	2
Miles City, Mont	30	14	19	13	n. 21 e.	17
Helena, Mont	15	24	12	31	s. 65 w.	21
Kalispell, Mont	13	7	17	33	n. 69 w.	17
Rapid City, S. Dak	15	17	11	31	s. 84 w.	20
Cheyenne, Wyo	22	19	7	27	n. 81 w.	20
Lander, Wyo	14	25	13	26	s. 50 w.	17
North Platte, Nebr	12	23	30	11	s. 60 e.	22
Middle Slope.						
Denver, Colo	19	22	12	26	s. 78 w.	14
Pueblo, Colo	23	12	19	22	n. 15 w.	11
Concordia, Kans	8	24	53	7	s. 58 e.	30
Dodge, Kans	15	24	31	9	s. 68 e.	24
Wichita, Kans	15	26	34	3	s. 70 e.	33
Oklahoma, Okla	13	23	28	8	s. 63 e.	22
Southern Slope.						
Abilene, Tex	15	27	29	4	s. 64 e.	28
Amarillo, Tex	8	39	24	9	s. 26 e.	34
Southern Plateau.						
El Paso, Tex	18	5	35	17	n. 54 e.	22
Santa Fe, N. Mex	21	19	31	6	n. 88 e.	25
Flagstaff, Ariz	23	9	10	33	n. 59 w.	27
Phoenix, Ariz	13	16	21	26	s. 59 w.	6
Yuma, Ariz	9	25	12	27	s. 43 w.	22
Independence, Cal	18	29	14	13	s. 5 e.	11
Middle Plateau.						
Carson City, Nev	5	20	4	43	s. 69 w.	42
Winnemucca, Nev	19	14	16	28	n. 67 w.	13
Modena, Utah	10	21	3	42	s. 74 w.	40
Salt Lake City, Utah	19	21	26	14	s. 81 e.	12
Grand Junction, Colo	16	17	30	14	s. 87 e.	16
Northern Plateau.						
Baker City, Oreg	20	30	13	13	s.	10
Boise, Idaho	12	21	19	24	s. 29 w.	10
Lewiston, Idaho†	1	3	28	0	s. 86 e.	28
Pocatello, Idaho	9	30	25	14	s. 28 e.	24
Spokane, Wash	15	19	23	14	s. 66 e.	10
Walla Walla, Wash	18	28	7	17	s. 45 w.	14
North Pacific Coast Region.						
Astoria, Oreg	14	25	1	38	s. 74 w.	39
Neah Bay, Wash	12	15	10	38	s. 84 w.	28
Port Crescent, Wash*	4	2	6	23	n. 83 w.	17
Seattle, Wash	24	16	7	25	n. 66 w.	20
Tacoma, Wash	40	9	1	17	n. 27 w.	35
Portland, Oreg	36	10	5	33	n. 47 w.	38
Roseburg, Oreg	40	4	7	24	n. 25 w.	40
Middle Pacific Coast Region.						
Eureka, Cal	10	16	3	39	n. 87 w.	36
Mount Tamalpais, Cal	18	7	1	49	n. 77 w.	49
Red Bluff, Cal	14	32	28	4	s. 53 e.	30
Sacramento, Cal	3	50	7	16	s. 11 w.	48
San Francisco, Cal	0	25	0	52	s. 64 w.	58
South Pacific Coast Region.						
Fresno, Cal	37	1	1	45	n. 51 w.	57
Los Angeles, Cal	4	11	5	49	s. 81 w.	45
San Diego, Cal	31	5	1	40	n. 56 w.	47
San Luis Obispo, Cal	4	9	1	48	s. 84 w.	47
West Indies.						
Basseterre, St. Kitts Island	13	2	56	0	n. 79 e.	57
Bridgetown, Barbados	18	6	52	0	n. 82 e.	52
Cienfuegos, Cuba	24	6	45	3	n 67 e.	46
Havana, Cuba	14	10	45	4	n. 84 e.	41
Kingston, Jamaica	51	0	23	1	n. 23 e.	55
Port of Spain, Trinidad	17	15	37	6	n. 87 e.	31
Puerto Principe, Cuba	17	6	48	1	n 75 e.	49
Roseau, Dominica, W. I	27	7	42	4	n. 62 e.	43
San Juan, Porto Rico	3	17	50	0	s. 74 e.	52
Santiago de Cuba, Cuba	33	14	30	4	n. 54 e.	32
Willemstad, Curaçao	8	9	52	2	s. 89 e.	50

* From observations at 8 p. m. only.

† From observations at 8 a. m. only.

TABLE IV.—*Thunderstorms and auroras, August, 1901.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	52	T.	3		3	2	3	4		4	2	5	6	4	2	5	2	2	3	4	6	7	5	4	5	2	1	3	6	3	2			98	29	T.
		A.																																0	0	A.
Arizona	56	T.	12	13	12	14	7	3	3	4	6	9	10	10	7	10	7	6	7	4	3				4	3	2	5	4	5	3	5		178	28	T.
		A.																																0	0	A.
Arkansas	57	T.			2	3	1			1	1	4	12	1	1	4	3		7	2	9	8	8	7	4	4	1	5	5	1	3	2	5	104	26	T.
		A.																																0	0	A.
California	167	T.	6	2	9	7	9	10	2		1			1		4	5	8	9	4	2	1								3	3	2	2	90	20	T.
		A.																																0	0	A.
Colorado	81	T.		3	10	21	21	14	16	21	16	18	10	6	1	8	7	8	10	7	3	12	3	5	14	9	9	12	20	18	14	24	10	350	30	T.
		A.																																0	0	A.
Connecticut	21	T.		1	1				4	1	2	4					3		9	5	1	7	6	1	1	10								56	15	T.
		A.																																0	0	A.
Delaware	5	T.	1										2	1			1			2	1				1	1								10	8	T.
		A.																																0	0	A.
Dist. of Columbia	4	T.						1					1				1			1					1								1	6	6	T.
		A.																																0	0	A.
Florida	47	T.	9	6	8	9	7	8	7	3	1	4	7	5	5	7	11	11	10	5	1	4	3	9	13	9	10	7	7	8	7	8	7	216	31	T.
		A.																																0	0	A.
Georgia	55	T.	7	1	2	6	12	11	5	2	2	10	5	3	6	5	7	6	1	3	5	7	9	8	10	4	6	5	10	5	10	3	2	178	31	T.
		A.																																0	0	A.
Idaho	34	T.	5	6				1	3								1	2	1	1	3	11	5		1			2				4		46	14	T.
		A.																																0	0	A.
Illinois	92	T.			1	2			4	3	1		1			6			22	20	7		10	31	13		2	19				3	1	146	17	T.
		A.	1																															1	1	A.
Indiana	58	T.		1			5									5	3		11	9	13	6	3	9	8			19	7			14		113	14	T.
		A.																																0	0	A.
Indian Territory	11	T.				1	1					2		2			1					1	1	4							1		1	15	10	T.
		A.																																0	0	A.
Iowa	149	T.			8			1	12	18	13	1	1		13	6	1		4	8		1	8	11		7	20	4		2	15			154	20	T.
		A.																																0	0	A.
Kansas	77	T.			5	11	1	6	4	3	13	8	4	3	12	9	1		6	2	4	1	8	7	1	4	6	1	3	3	11		3	140	27	T.
		A.																																0	0	A.
Kentucky	41	T.										1	2	1		1			1	2	10	3	3	6	7	1	1	10	7			1	1	58	17	T.
		A.																																0	0	A.
Louisiana	46	T.	4	1		4	8	3	3	6	7	6	6	10	7	6	2	1	1	3	10	12	5	4	4	4	2	7	6	8	8	3	1	152	30	T.
		A.																																0	0	A.
Maine	19	T.				1			1	6	3	4	1		1	1	1	2					4								1	1		27	13	T.
		A.																																0	0	A.
Maryland	48	T.				1		6				4	3	9		1	13	3	9	6	12	5	4	4	12	4	2	2	3			9	22	134	21	T.
		A.	1			1														1			1									1		5	5	A.
Massachusetts	48	T.		1		6		1	2	5		7		1			2		9	4		6	1	1		15	8							69	15	T.
		A.																																0	0	A.
Michigan	106	T.		1				2	10	1	2	1		2	3	5	1			5	6	5	2	18	8		4	8		4	12	16	1	117	22	T.
		A.																																0	0	A.
Minnesota	67	T.	1		1		3	10	1	8	11	4	4	6	14	2			1	1		2	6	5	4	21	14	3		17	8			147	23	T.
		A.																																0	0	A.
Mississippi	44	T.	2	1	1	7	7	1	2	3	6	7	10	11	7	6	3	3	2	2	6	8	3	3	4	4	3	6	3	9	2	1		133	31	T.
		A.																																0	0	A.
Missouri	95	T.	1		16	24	2			3	14	4	14		6	22	3	5	25	8	9	8	12	14	6	4	8	18	2	2	13	3		246	26	T.
		A.																										1						1	1	A.
Montana	40	T.	1	6				1		2			1		2	3	1	1				6	2	2	2	5		4		1		1		41	17	T.
		A.														1																		1	1	A.
Nebraska	142	T.		1	18	3		10	6	19	18	26	15	4	25	8			2	8	1	6	13	6	16	9	15	7	7	2	13	2	2	257	27	T.
		A.																																0	0	A.
Nevada	40	T.	7	4	5	6	12	9	7	2	2				1	4	6	5	8	7	4	1	1									1		92	19	T.
		A.																																0	0	A.
New Hampshire	19	T.		1		3			3	10	1	8				1	2	1				4	1			4						1		40	13	T.
		A.																																0	0	A.
New Jersey	51	T.				8	1	4	4			8	3	16			12	2	6	11	12	4	14	4	9	14							8	140	18	T.
		A.																																0	0	A.
New Mexico	31	T.	1			4	5	4	9	11	3	8	6	5	2	3	6		7	6	2	1			1	5	4	3	4	3	4	16	4	117	26	T.
		A.																																0	0	A.
New York	99	T.			1	5		1	4	42	12	12	1			1	5	3	4	1	6	35	18	33	35	8	1	3			1	20	21	273	24	T.
		A.													1				1															2	2	A.
North Carolina	56	T.	6	2		5	11	12	4			7	13	11	8	7	8	8	1	3	7	7	8	3	4	12	5	11	6	2	1		14	186	27	T.
		A.																																0	0	A.
North Dakota	48	T.								6		4		2		1			1	2		8	2		2	5		1	3	1			1	39	13	T.
		A.						1								1																		2	2	A.
Ohio	128	T.	1				1									5	15		17	30	27	23	11	24	26	3			11	1	1	43	13	252	17	T.
		A.		1								1												1								1		4	4	A.
Oklahoma	23	T.				3	1				1	3	6	3		1				2	1	3	2	1	1					2	5	6		41	16	T.
		A.																																0	0	A.
Oregon	74	T.	1				1	7	14								4	1	5	3	3	4		7	2		17	3			2	3	7	84	17	T.
		A.													1																	1		2	2	A.
Pennsylvania	91	T.					2	3	4	10	4	18	1	4			16	1	14	10	13	5	14	16	18	13	1		1		1	20	16	205	23	T.
		A.																																0	0	A.
Rhode Island	7	T.				2				1							1		2			1				1	1							9	7	T.
		A.																																0	0	A.
South Carolina	46	T.	6	5		1	11	13	3	3	3	5	7	5	10	7	4	5	3	1	7	9	4	3	9	12	8	2	10	13	4	8	7	188	30	T.
		A.																																0	0	A.
South Dakota	56	T.		1			1	6		12	8	12	3	4	7	4		1	5	2	3	4	2	2	1	4	4	1	2	3	1			93	24	T.
		A.																																0	0	A.
Tennessee	56	T.				3	6	2				7	9	8	7	7	3	2	4	8	7	9	4	6	8			10	7	1	1		6	125	22	T.
		A.																																0	0	A.
Texas	95	T.	3	1	2		5	2	2		1		1	2	6	3		1		1	4	7	8	2		1					4	7	4	67	21	T.
		A.																																0	0	A.
Utah	47	T.	15	4	10	9	8	15	8	11	9	3			3	7	12	14	8	13	15	4	1		2	3	1	9	6	2	5	4	1	202	28	T.
		A.																																0	0	A.
Vermont	16	T.							4	6	1	5					3				1	2	1			1							1	25	10	T.
		A.																																0	0	A.
Virginia	50	T.	3			4		7	1			2	11	8	3	1	6	4	3	1	3	1	1		7	12	3	5	2	2		3	13	106	24	T.
		A.																																0	0	A.
Washington	64	T.	1						1								2	2			1	2			1		5	1				1	1	18	11	T.
		A.																																0	0	A.
West Virginia	48	T.	1					2				9	2	1		2		1	1	3	14	10	9	8	11	7	1	6	6		1	19	8	122	21	T.
		A.																																0	0	A.
Wisconsin	60	T.	4	3	1		1	3	6	2	4	1	1	2	4	5				6		1	3	16	1	2	9	13	1	1	7			97	24	T.
		A.																																0	0	A.
Wyoming	31	T.	7	7	1	1		1	3	2	1	2		1	1	3	2	2		2	4	10	3	2	3	5	1	4	6	5	3	6	1	89	28	T.
		A.																																0	0	A.
Sums	2,898	T.	108	72	112	176	153	184	162	181	169	243	179	152	164	186	187	111	239	228	246	282	231	286	280	232	175	219	155	127	167	250	185	5,891	....	T.
		A.	2	1	0	1	0	1	0	0	0	1	0	1	1	2	0	0	1	1	0	0	1	1	0	0	0	1	0	0	0	0	3	18	....	A.

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded* 0.25 *in any* 5 *minutes, or* 0.75 *in* 1 *hour during August*, 1901, *at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total am't of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y.	6-7	5.30 p.m.	8.15 a.m.	2.68	6.20 a.m.	6.50 a.m.	1.76	0.05	0.12	0.14	0.28	0.35	0.46	0.72	0.83	0.85	0.87				
Alpena, Mich.	22			0.42														0.33			
Atlanta, Ga.	6	10.17 a.m.	10.55 a.m.	0.86	10.20 a.m.	10.35 a.m.	T.	0.32	0.64	0.83	0.85										
Do	21-22	8.43 p.m.	5.15 p.m.	3.66	8.55 a.m.	10.05 a.m.	0.92	0.05	0.18	0.34	0.61	0.87	1.07	1.25	1.34	1.44	1.53	1.64	1.82		
Atlantic City, N. J.	12	3.48 p.m.	D. N.	2.46	4.48 p.m.	6.45 p.m.	0.10	0.07	0.15	0.30	0.40	0.52	0.62	0.75	0.81	0.84	0.92	1.05	1.45	1.76	2.02
Baltimore, Md.	6	D. N.	12.25 p.m.	2.05	11.15 a.m.	11.45 a.m.	1.08	0.05	0.09	0.32	0.56	0.77	0.92								
Do	12	10.37 a.m.	2.05 p.m.	1.43	11.45 a.m.	12.20 p.m.	0.09	0.06	0.10	0.31	0.43	0.78	1.00	1.10							
Do	27	6.35 p.m.	7.30 p.m.	0.81	6.40 p.m.	6.55 p.m.	0.02	0.30	0.62	0.76	0.78										
Binghamton, N. Y.	23-24			1.10														0.46			
Bismarck, N. Dak.	8	3.42 p.m.	4.35 p.m.	0.60	4.00 p.m.	4.20 p.m.	0.04	0.07	0.31	0.45	0.53	0.56									
Boise, Idaho	2			0.01																	
Boston, Mass.	24-25	6.35 p.m.	D. N.	2.08	11.20 p.m.	12.25 a.m.	0.21	0.07	0.13	0.26	0.35	0.53	0.72	0.89	1.24	1.33	1.43	1.76	1.90		
Buffalo, N. Y.	24			0.33								0.33									
Cairo, Ill.	26			0.74														0.67			
Charleston, S. C.	7	12.38 p.m.	2.56 p.m.	1.17	2.15 p.m.	2.45 p.m.	T	0.08	0.31	0.54	0.62	0.92	1.17								
Chicago, Ill.	17-18			0.74														0.51			
Cincinnati, Ohio	23			0.18														0.15			
Cleveland, Ohio	17	4.13 p.m.	7.06 p.m.	1.82	6.00 p.m.	6.55 p.m.	0.86	0.10	0.28	0.41	0.48	0.61	0.69	0.73	0.78	0.85	0.89	0.94			
Do	20	4.11 p.m.	5.10 p.m.	1.78	4.30 p.m.	4.50 p.m.	T.	0.37	1.04	1.46	1.77	1.78									
Columbia, Mo.	3-4																	*			
Columbus, Ohio	30	4.53 p.m.	7.35 p.m.	0.90	5.50 p.m.	6.10 p.m.	0.17	0.15	0.25	0.58	0.68										
Denver, Colo.	3			0.46							0.24										
Des Moines, Iowa	22			0.08														0.08			
Detroit, Mich.	22	10.45 p.m.	D. N.	0.73	11.00 p.m.	11.15 p.m.	0.04	0.19	0.41	0.52	0.54	0.55	0.61	0.69							
Do	23	5.10 p.m.	7.00 p.m.	1.56	5.19 p.m.	5.53 p.m.	0.05	0.35	0.67	0.80	0.97	1.10	1.22	1.31	1.35						
Dodge, Kans	28-29			0.24														0.20			
Duluth, Minn.	8-9			0.71														*			
Eastport, Me.	11			0.70														0.65			
Elkins, W. Va	30			0.75														0.66			
Erie, Pa.	22			1.14														0.71			
Escanaba, Mich.	22			0.76														0.69			
Evansville, Ind	23	2.25 a.m.	4.30 a.m.	1.02	3.10 a.m.	3.25 a.m.	0.45	0.21	0.47	0.54	0.55										
Fort Worth, Tex.	13			0.19											0.19						
Fresno, Cal.	16			T.																	
Galveston, Tex.	7	5.15 a.m.	10.30 a.m.	1.71	5.55 a.m.	6.40 a.m.	0.03	0.12	0.25	0.37	0.55	0.63	0.71	0.77	0.81	0.84					
					8.56 a.m.	9.20 a.m.	1.01	0.06	0.19	0.37	0.49	0.54	0.57								
Do	22	1.30 a.m.	12.15 p.m.	3.13	3.45 a.m.	4.15 a.m.	0.22	0.25	0.54	0.63	0.77	1.22	1.29	1.31							
Grand Junction, Colo.	16			0.37												0.37					
Harrisburg, Pa	6			1.41														0.34			
Hatteras, N. C.	25			0.63														0.54			
Huron, S. Dak.	8	9.45 p.m.	11.45 p.m.	1.33	9.50 p.m.	10.35 p.m.	0.02	0.13	0.36	0.69	0.92	1.02	1.08	1.13	1.18	1.23					
Indianapolis, Ind.	19	3.30 p.m.	4.15 p.m.	1.19	3.42 p.m.	4.05 p.m.	0.03	0.27	0.65	0.96	1.07	1.15									
Jacksonville, Fla.	16	3.40 p.m.	8.12 p.m.	1.35	3.40 p.m.	4.10 p.m.	0.00	0.11	0.83	1.00	1.08	1.22	1.28								
Jupiter, Fla.	2	11.28 a.m.	7.25 p.m.	1.57	2.38 p.m.	2.55 p.m.	0.15	0.33	0.74	1.14	1.22										
Do	13	12.27 a.m.	2.30 a.m.	0.78	12.30 a.m.	12.40 a.m.	T.	0.34	0.58	0.62											
Do	16-17	8.19 p.m.	11.55 a.m.	1.61	5.12 a.m.	5.30 a.m.	0.45	0.32	0.52	0.78	0.85	0.86									
Do	29	6.12 p.m.	8.50 p.m.	2.12	6.16 p.m.	6.50 p.m.	T.	0.20	0.56	0.73	0.86	0.95	1.09	1.21	1.21	1.21	1.21	1.22	1.34	1.86	2.08
Kalispell, Mont	7-8			0.11														0.06			
Kansas City, Mo.	3-4			1.59														0.72			
Key West, Fla.	2	6.58 p.m.	9.00 p.m.	1.96	7.00 p.m.	7.40 p.m.	T.	0.23	0.40	0.53	0.75	1.05	1.37	1.63	1.77	1.80	1.83	1.86			
Knoxville, Tenn	5-6	7.40 p.m.	8.30 a.m.	1.17	4.10 a.m.	4.45 a.m.	0.40	0.12	0.16	0.22	0.24	0.44	0.55	0.64							
Do	12	4.05 p.m.	9.50 p.m.	0.74	4.15 p.m.	4.25 p.m.	0.01	0.20	0.36	0.38											
Lexington, Ky.	20			0.46								0.40									
Lincoln, Nebr.	10-11			0.21														0.16			
Little Rock, Ark.	11			0.78														0.65			
Los Angeles, Cal.	5			0.08						0.08											
Louisville, Ky.	19	2.55 p.m.	3.35 p.m.	0.52	3.05 p.m.	3.25 p.m.	T.	0.09	0.29	0.41	0.49	0.52									
Macon, Ga.	5	4.40 p.m.	6.00 p.m.	1.06	4.49 p.m.	5.15 p.m.	T.	0.23	0.46	0.69	0.88	1.01	1.05								
Memphis, Tenn.	18-19	10.32 p.m.	D. N.	1.40	11.00 p.m.	11.25 p.m.	0.11	0.13	0.28	0.52	0.77	0.96	1.01	1.05	1.07						
Meridian, Miss.	4	5.33 p.m.	6.25 p.m.	0.95	5.35 p.m.	6.10 p.m.	T.	0.09	0.13	0.26	0.56	0.73	0.85	0.92							
Milwaukee, Wis.	22			0.63														0.62			
Montgomery, Ala.	6	3.50 a.m.	8.10 a.m.	1.50	3.57 a.m.	4.45 a.m.	0.01	0.07	0.21	0.35	0.62	0.67	0.85	0.98	1.06	1.29	1.35	1.88			
Do	19	1.59 p.m.	2.57 p.m.	1.41	2.07 p.m.	2.35 p.m.	0.02	0.26	0.61	0.95	1.18	1.29	1.35								
Nantucket, Mass.	4	3.45 p.m.	8.50 p.m.	1.02	4.23 p.m.	4.43 p.m.	0.08	0.17	0.45	0.68	0.81	0.84									
Nashville, Tenn.	23			1.28														0.72			
New Haven, Conn.	17-18	8.20 p.m.	6.45 a.m.	3.26	8.35 p.m.	10.15 p.m.	0.01	0.07	0.24	0.44	0.51	0.59	0.68	0.71	0.80	0.85	0.87	0.94	1.09	1.62	
Do	24	2.12 p.m.	11.45 p.m.	2.55	4.00 p.m.	5.20 p.m.	0.22	0.06	0.15	0.17	0.23	0.37	0.51	0.63	0.73	0.86	0.94	1.01	1.35		
New Orleans, La.	22	1.15 p.m.	1.50 p.m.	1.01	1.20 p.m.	1.40 p.m.	0.02	0.34	0.66	0.87	0.94	0.98	0.99								
New York, N. Y.	24	11.45 a.m.	4.20 p.m.	2.74	12.55 p.m.	1.40 p.m.	0.13	0.12	0.24	0.30	0.35	0.41	0.48	0.55	0.67	0.86					
					3.24 p.m.	4.00 p.m.	1.44	0.32	0.82	0.96	0.99	1.00	1.12	1.25	1.29						
Norfolk, Va.	12-13	8.18 p.m.	9.30 a.m.	2.84	8.23 p.m.	9.30 p.m.	T.	0.33	0.70	0.96	1.08	1.13	1.32	1.43	1.50	1.59	1.61	1.79	1.93		
Do	31	12.40 p.m.	5.15 p.m.	1.96	2.10 p.m.	2.40 p.m.	0.07	0.09	0.45	1.00	1.44	1.66	1.72	1.76	1.80						
Northfield, Vt.	6-7			1.15														0.27			
Oklahoma, Okla.	12	5.40 a.m.	9.45 a.m.	1.83	5.45 a.m.	6.45 p.m.	T.	0.04	0.29	0.47	0.58	0.72	0.95	1.08	1.14	1.17	1.37	1.58	1.71		
Omaha, Nebr.	9			0.37														0.09			
Parkersburg, W. Va.	30			0.60														0.39			
Philadelphia, Pa.	19	4.22 p.m.	5.12 p.m.	0.71	4.23 p.m.	4.40 p.m.	T.	0.23	0.49	0.63	0.67	0.69									
Pittsburg, Pa.	24	1.15 p.m.	3.15 p.m.	0.94	1.22 p.m.	1.40 p.m.	T.	0.13	0.44	0.74	0.82	0.84									
Pocatello, Idaho	29			0.08														0.06			
Portland, Me.	24-25			2.23														0.60			
Portland, Oreg.	25-26			0.17														0.08			
Pueblo, Colo.	31			0.79														0.66			
Raleigh, N. C.	5	12.32 p.m.	5.40 p.m.	2.51	12.32 p.m.	1.25 p.m.	0.00	0.12	0.24	0.36	0.59	0.91	1.07	1.17	1.20	1.44	1.61	1.75			
Do	13	7.20 a.m.	11.00 a.m.	1.70	7.55 a.m.	8.55 a.m.	0.05	0.06	0.16	0.31	0.46	0.64	0.84	0.97	1.02	1.14	1.24	1.38			
Do	14	6.55 a.m.	7.43 a.m.	0.62	7.15 a.m.	7.32 a.m.	0.01	0.05	0.15	0.32	0.53	0.59	0.61								
Richmond, Va.	6	3.21 p.m.	D. N.	1.61	3.45 p.m.	4.03 p.m.	0.07	0.35	0.58	0.83	0.95										
Do	12	11.14 a.m.	11.50 a.m.	0.68	11.20 a.m.	11.45 a.m.	0.05	0.09	0.17	0.26	0.43	0.63									
Rochester, N. Y.	6-7			1.28														*			
St. Louis, Mo.	22-23			0.34											0.27						
St. Paul, Minn.	8-9			0.56														0.36			
Salt Lake City, Utah	19			0.38														0.31			
San Diego, Cal.	3			T.																	
Sandusky, Ohio	22	1.26 p.m.	1.53 p.m.	0.68	1.31 p.m.	1.40 p.m.	0.01	0.45	0.56	0.67											
Do	30	1.58 p.m.	4.09 p.m.	0.93	2.25 p.m.	3.00 p.m.	0.02	0.09	0.10	0.15	0.25	0.41	0.68	0.78	0.81	0.83					
San Francisco, Cal.	28-29			T.																	
Savannah, Ga.	7	1.04 p.m.	3.40 p.m.	0.91	1.18 p.m.	1.40 p.m.	T.	0.20	0.39	0.50	0.73	0.77									
Do	25	2.32 p.m.	3.25 p.m.	0.98	2.45 p.m.	3.05 p.m.	T.	0.17	0.55	0.81	0.96	0.97									
Seattle, Wash.	26			0.12														0.05			
Spokane, Wash.	20			0.01																	
Springfield, Ill.	17-18			1.57														0.40			

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total am't of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Tampa, Fla.	17	1.23 p.m.	11.55 p.m.	2.78	7.20 p.m.	8.10 p.m.	0.30	0.14	0.44	0.52	0.54	0.76	1.14	1.59	1.77	1.93	1.98	2.03			
Toledo, Ohio	30	4.05 p.m.	7.20 p.m.	1.42	6.30 p.m.	6.45 p.m.	0.54	0.24	0.46	0.71	0.74	0.75									
Topeka, Kans.	4	12.55 a.m.	3.55 a.m.	0.80	1.35 a.m.	2.00 a.m.	0.18	0.07	0.13	0.23	0.44	0.54	0.56								
Valentine, Nebr.	20	7.40 p.m.	10.10 p.m.	0.73	7.50 p.m.	8.10 p.m.	T.	0.20	0.36	0.50	0.55										
Vicksburg, Miss.	14	1.43 p.m	D. N.	1.10	4.22 p m	4.40 p.m.	0.50	0.08	0.21	0.39	0.53	0.54									
Washington, D. C.	23	3.00 p.m.	4.20 p.m.	0.58	3.04 p.m.	3.20 p.m.	T.	0.12	0.35	0.43	0.46										
Wilmington, N. C.	17			0.73														0.59			
Yankton, S. Dak	9	1.15 a.m.	3.00 a.m.	0.90	1.20 a.m.	1.50 a.m.	0.01	0.15	0.31	0.39	0.49	0.62	0.74	0.77	0.80						
Basseterre, St. Kitts	21			0.50											0.50						
Bridgetown, Barbados	19-20	5.30 a.m.	10.25 p.m.	8.65	7.50 a.m.	8.15 a.m.	0.16	0.06	0.12	0.21	0.30	0.35	0.40	0.47	0.57	0.63	0.69	0.90	1.33		
					11.40 a.m.	12.25 p.m.	1.82	0.10	0.23	0.32	0.33	0.41	0.55	0.74	0.91	1.10	1.11	1.18			
					5.40 p.m.	6.30 p.m.	4.84	0.13	0.27	0.35	0.50	0.60	0.69	0.75	0.89	1.03	1.09	1.17	1.43		
					7.30 p.m	8.25 p.m	6.51	0.12	0.29	0.51	0.72	0.88	1.10	1.21	1.37	1.59	1.70	1.98			
Cienfuegos, Cuba	30	5.14 p.m.	8.00 p.m.	0.61	5.18 p.m.	5.40 p.m.	T.	0.18	0.37	0.44	0.54	0.59									
Havana Cuba	14	2.30 p.m.	4.10 p.m	1.24	2.33 p m.	2.55 p.m.	T.	0.25	0.64	0.93	1.08	1.14									
Do	22	5.20 p.m.	6.25 p.m.	1.88	5.30 p.m	6.10 p.m.	0.03	0.11	0.29	0.48	0.90	1.14	1.35	1.58	1.80						
Do	30	3.23 p.m.	7.15 p.m.	1.33	3.35 p.m.	4.00 p.m.	0.01	0.12	0.31	0.54	0.74	0.84	0.88	0.93							
Kingston, Jamaica	21			0.43									0.43								
Port of Spain, Trin.	6	8.27 a.m.	10.15 a.m.	1.13	8.45 a.m.	9.10 a.m.	0.01	0.17	0.38	0.58	0.79	0.87	0.88	0.95	1.00	1.05					
Do	17	10.34 a.m.	11.09 a.m.	0.70	10.35 a m.	10.55 a.m.	T.	0.13	0.40	0.63	0.69	0.70									
Do	18	12.02 p.m.	12.39 p.m.	1.02	12.04 p.m.	12.34 p.m.	T.	0.07	0.19	0.39	0.65	0.91	1.02								
Puerto Principe, Cuba	8			0.53														0.53			
Roseau, Dominica	29	8.02 a.m.	10.04 a.m.	1.54	8.49 a.m.	9.50 a.m.	0.01	0.12	0.27	0.46	0.56	0.76	0.87	1.03	1.07	1.13	1.27	1.50			
San Juan, Porto Rico	20	9.25 a.m.	12.25 p.m.	1.35	11.30 a.m.	12.01 p.m	0.14	0.25	0.41	0.56	0.83	1.11	1.28								
Do	22	4.10 p.m.	6.35 p m.	1.23	5.14 p.m.	5.38 p m	0.10	0.21	0.44	0.56	0.66	0.76	0.77	0.85							
Do	31	10.10 a.m.	11.05 a.m.	0.86	10.37 a.m.	10.57 a.m.	0.08	0.29	0.45	0.63	0.76	0.78									
Santiago de Cuba	6			0.50									0.50								
Santo Domingo, W.I.	1	1.15 p.m.	1.40 p.m.	0.75	1.15 p m.	1.32 p.m.	0.00	0.25	0.55	0.71	0.74										
Do	17	12.50 p.m.	1.30 p.m.	0.97	12.53 p m.	1.12 p.m.	T.	0.28	0.68	0.88	0.95										
Do	30	3.35 p.m.	5.15 p.m.	0.70	3.35 p.m.	3.55 p.m.	0.00	0.23	0.39	0.53	0.61	0.63									
Willemstad, Curaçao	30			0.38														0.34			

*Self register not working.

TABLE VI.—*Data furnished by the Canadian Meteorological Service, August, 1901.*

Stations.	Pressure. Mean not reduced.	Pressure. Mean reduced.	Pressure. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Depth of snow.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
St. Johns, N. F.	29.87	30.01	+.03	61.6	+ 1.8	69.4	53.7	4.84	+0.59	
Sydney, C. B. I.	30.02	30.06	+.10	67.1	+ 3.8	75.9	58.2	1.92	−1.98	
Halifax, N. S.	29.96	30.07	+.09	67.8	+ 4.2	76.3	59.3	3.66	+0.10	
Grand Manan, N. B.	30.01	30.06	+.10	63.5	+ 2.0	70.6	56.4	3.75	+0.66	
Yarmouth, N. S.	30.01	30.09	+.09	63.4	+ 3.2	71.2	55.6	2.88	−0.34	
Charlottet'n, P. E. I.	29.99	30.03	+.08	68.2	+ 3.9	76.8	59.5	3.31	−0.09	
Chatham, N. B.	30.00	30.02	+.08	66.7	+ 3.5	77.4	56.0	1.76	−2.38	
Father Point, Que.	29.94	29.97	+.06	56.9	+ 1.3	66.4	47.4	2.04	−0.52	
Quebec, Que.	29.68	30.00	+.05	65.5	+ 2.4	74.5	56.5	5.83	+2.41	
Montreal, Que.										
Bissett, Ont.	29.43	30.03	+.09	63.4	+ 0.2	77.8	49.0	4.79	+1.86	
Ottawa, Ont	29.73	30.04	+.10	68.3	+ 3.5	78.3	58.3	3.23	+0.18	
Kingston, Ont	29.71	30.02	+.05	68.4	+ 1.4	75.2	61.6	3.21	+1.22	
Toronto, Ont	29.64	30.01	+.02	69.0	+ 3.0	78.2	59.9	3.86	+1.28	
White River, Ont.	28.72	30.04	+.06	59.8	+ 3.4	74.9	44.7	0.73	−2.33	
Port Stanley, Ont	29.39	30.01	+.02	68.8	+ 2.9	78.1	59.4	1.54	−0.85	
Saugeen, Ont.	29.33	30.02	+.04	66.7	+ 2.9	74.3	59.1	2.04	+0.26	
Parry Sound, Ont	29.34	30.01	+.04	66.1	+ 2.6	75.9	56.3	4.08	+1.40	
Port Arthur, Ont.	29.30	29.98	+.05	62.1	+ 2.6	71.6	52.5	2.92	+0.55	
Winnipeg, Man.	29.17	29.97	+.06	64.6	+ 1.2	77.7	51.4	1.70	−1.76	
Minnedosa, Man.	28.21	29.96	+.06	63.5	+ 4.1	77.2	49.9	0.83	−1.03	
Qu'Appelle, Assin.	27.75	29.93	+.03	63.3	+ 1.8	76.7	50.0	0.77	−0.70	
Medicine Hat, Assin.										
Swift Current, Assin.	27.46	29.95	+.03	65.7	+ 1.7	80.0	51.3	0.56	−1.18	
Calgary, Alberta	26.47	29.91	+.01	59.3	− 0.1	74.0	44.6	0.71	−1.06	
Banff, Alberta	25.45	29.99	+.07	56.6	+ 0.3	73.2	40.1	0.82	−0.50	
Edmonton, Alberta	27.68	29.91	.00	61.4	+ 2.6	75.1	47.6	0.72	−1.11	
Prince Albert, Sask.	28.40	29.90	.00	60.7	+ 1.8	73.5	47.9	1.49	+0.07	
Battleford, Sask.	28.26	29.94	+.04	63.2	+ 0.6	76.8	49.6	0.91	−0.87	
Kamloops, B. C	28.69	29.92	−.03	72.0	+ 3.4	88.4	55.7	0.00	−0.56	
Victoria, B. C	29.93	30.03	+.01	61.0	+ 2.3	69.6	52.4	0.00	−0.59	
Barkerville, N. W. T.	25.75	29.96		56.2	− 0.1	72.1	40.4	0.94	−1.90	
Hamilton, Bermuda.	29.98	30.14	+.04	83.0	+ 3.4	90.3	75.8	2.27	−3.83	

TABLE VII.—*Heights of rivers referred to zeros of gages, August, 1901.*

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
St. Paul, Minn	1,954	14	3.8	1	2.3	13	2.8	1.5
Reeds Landing, Minn	1,884	12	3.1	2	1.3	28	2.1	1.8
La Crosse, Wis	1,819	12	4.6	1	2.2	30,31	3.2	2.4
Prairie du Chien, Wis	1,759	18	4.2	1	1.6	31	2.8	2.6
Dubuque, Iowa	1,699	15	4.6	1	2.2	31	3.3	2.4
Leclaire, Iowa	1,609	10	3.4	1	1.2	30,31	1.9	2.2
Davenport, Iowa	1,593	15	4.1	1	2.0	30,31	2.8	2.1
Muscatine, Iowa	1,562	16	5.3	1	2.5	30,31	3.5	2.8
Galland, Iowa	1,472	8	2.3	1	0.8	31	1.4	1.5
Keokuk, Iowa	1,463	15	3.6	1	0.9	29-31	1.9	2.7
Hannibal, Mo	1,402	13	4.5	1	1.8	29-31	2.8	2.7
Grafton, Ill	1,306	23	6.0	1	3.4	29-31	4.4	2.6
St. Louis, Mo	1,264	30	8.4	2,3	3.7	31	5.9	4.7
Chester, Ill	1,189	36	6.4	3,4	3.0	31	4.6	3.4
New Madrid, Mo	1,003	34	20.3	27,28	6.7	13	12.2	13.6
Memphis, Tenn*	843	33	16.7	29	2.9	15	7.3	13.8
Helena, Ark	767	42	23.4	30	6.4	16	11.9	17.0
Arkansas City, Ark	635	42	22.7	31	6.4	16,17	11.0	16.3
Greenville, Miss	595	42	18.6	31	5.4	16,17	8.9	13.2
Vicksburg, Miss	474	45	18.6	31	4.3	18,19	8.0	14.3
New Orleans, La	108	16	11.4	15	3.7	18	4.4	7.7
Missouri River.								
Bismarck, N. Dak	1,309	14	3.9	1	1.1	29-31	2.3	2.8
Pierre, S. Dak	1,114	14	5.3	1,2	3.1	30,31	4.2	2.2
Sioux City, Iowa	784	19	8.5	1,2	6.0	31	7.3	2.5
Omaha, Nebr	669	18	8.9	1,3,4	6.9	28-31	7.9	2.0
St. Joseph, Mo	481	10	3.9	1	1.6	31	2.8	2.3
Kansas City, Mo	388	21	10.4	1	7.2	31	8.6	3.2
Boonville, Mo	199	20	8.9	3	6.3	31	7.5	2.6
Hermann, Mo	103	24	7.4	1	4.4	31	5.8	3.0
Illinois River.								
Peoria, Ill	135	14	6.4	1	5.9	9-20	6.0	0.5
Youghiogheny River.								
Confluence, Pa	59	10	3.0	25	0.2	13,19	1.0	2.8
West Newton, Pa	15	23	1.6	25	0.1	5-8, 15, 18, 19,	0.4	1.5
Allegheny River.								
Warren, Pa	177	14	2.1	24	0.1	12-19	0.7	2.0
Oil City, Pa	123	13	3.0	26	0.6	15,16	1.3	2.4
Parker, Pa	73	20	3.5	25	0.4	11	1.5	3.1
Monongahela River.								
Weston, W. Va	161	18	0.0	31	−0.6	5-10	−0.3	0.6
Fairmont, W. Va	119	25	1.0	25-31	0.2	1-8	0.6	0.8
Greensboro, Pa	81	18	7.9	26	6.1	15-22	6.5	1.8
Lock No. 4, Pa	40	28	9.5	26	4.7	10	6.7	4.8
Conemaugh River.								
Johnstown, Pa	64	7	2.8	24	1.1	13-15	1.5	1.7
Red Bank Creek.								
Brookville, Pa	35	8	2.1	21	−0.5	1-15	0.4	2.6
Beaver River.								
Ellwood Junction, Pa	10	14	4.5	20, 25, 26	1.3	14, 15	2.7	3.2
Great Kanawha River.								
Charleston, W. Va	58	30	15.2	8	5.0	12	7.4	10.2
Little Kanawha River.								
Glenville, W. Va	103	20	2.5	12	−2.2	4,5	−0.5	4.7
New River.								
Hinton, W. Va	95	14	12.5	7	2.0	5	4.9	10.5
Cheat River.								
Rowlesburg, W. Va	36	14	4.0	25	0.2	14,19,20	1.3	3.7
Ohio River.								
Pittsburg, Pa	966	22	7.0	26	5.1	28	5.9	1.9
Davis Island Dam, Pa	960	25	6.3	26	2.0	9	3.5	4.3
Wheeling, W. Va	875	36	7.7	27	1.7	14	4.0	6.0
Parkersburg, W. Va	785	36	7.5	27	1.9	15	4.1	5.6
Point Pleasant, W. Va	703	39	10.4	31	2.7	3,6	62	7.7
Huntington, W. Va	660	50	14.6	9	5.1	4	9.1	9.5
Catlettsburg, Ky	651	50	13.7	9	2.3	4-7	7.9	11.4
Portsmouth, Ohio	612	50	13.8	9	4.7	4-7	9.1	9.1
Cincinnati, Ohio	499	50	12.8	11	5.8	7,8	9.6	7.0
Madison, Ind	413	46	11.2	21	5.3	6	8.6	5.9
Louisville, Ky	367	28	6.5	21,30	3.3	8-11	5.1	3.2
Evansville, Ind	184	35	9.6	24	3.4	13	6.3	6.2
Paducah, Ky	47	40	22.4	26	2.6	12	10.6	19.8
Cairo, Ill	1,073	45	25.1	27	6.6	13	14.3	18.5
Muskingum River.								
Zanesville, Ohio	70	20	8.5	31	5.8	1,2	6.7	2.7
Scioto River.								
Columbus, Ohio	110	17	2.0	1,16-18	1.8	11-13	1.9	0.2
Miami River.								
Dayton, Ohio	77	18	1.0	20,22	0.4	10	0.7	0.6
Wabash River.								
Mount Carmel, Ill	50	15	1.4	24	0.7	14-21	0.9	0.7
Licking River.								
Falmouth, Ky	30	25	2.0	23	0.5	11-14	1.2	1.5
Kentucky River.								
Frankfort, Ky	65	31	7.8	16, 18-20	5.2	1-3, 11, 12	6.2	2.6
Clinch River.								
Speers Ferry, Va	156	20	7.3	13	−0.4	1	1.3	7.7
Clinton, Tenn	52	25	27.1	15	2.7	3	8.4	24.4
Tennessee River.								
Knoxville, Tenn	635	29	17.5	15	1.3	5	7.8	16.2
Kingston, Tenn	556	25	20.9	16	1.7	1,5	7.4	19.2
Chattanooga, Tenn	452	33	33.8	17	2.6	5,6	12.5	31.2
Bridgeport, Ala	402	24	24.5	18	1.2	6,7	9.6	23.3
Florence, Ala	255	16	19.0	22	0.9	5	8.5	18.1
Riverton, Ala	225	25	29.7	23	0.3	1,4,5	12.6	29.4
Johnsonville, Tenn	95	24	27.6	26	1.8	3-7	12.9	25.8
Cumberland River.	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
Burnside, Ky	516	50	45.6	16	0.3	11	10.6	45.3
Carthage, Tenn	305	40	38.0	20	0.5	3	11.9	37.5
Nashville, Tenn	189	40	39.8	21	1.3	4,5	15.0	59.2
Clarksville, Tenn	126	42	43.9	24	1.0	6	17.1	48.3
Arkansas River.								
Wichita, Kans	832	10	1.6	11	0.8	25-31	1.1	0.8
Webbers Falls, Ind. T	465	23	3.2	6	1.5	27-31	1.8	1.7
Fort Smith, Ark	403	22	3.6	1	0.9	30,31	2.0	2.7
Dardanelle, Ark	256	21	3.2	11	0.5	1	1.6	2.7
Little Rock, Ark	176	23	4.3	13	1.9	1	2.7	2.4
White River.								
Newport, Ark	150	26	0.2	5-9, 21-28	0.0	1-4, 29-31	0.1	0.2
Yazoo River.								
Yazoo City, Miss	80	25	9.1	31	−1.4	1-3, 11	2.6	10.5
Red River.								
Arthur City, Tex	638	27	9.3	6	4.0	31	5.2	5.3
Fulton, Ark	515	28	10.5	4,9	4.5	23	6.8	6.0
Shreveport, La	327	29	5.6	7	1.4	1	3.3	4.2
Alexandria, La	118	33	2.4	17	−0.6	1	1.0	3.0
Ouachita River.								
Camden, Ark	304	39	4.8	9	3.0	26-31	3.7	1.8
Monroe, La	122	40	3.7	24	0.6	9-11	1.7	3.1
Atchafalaya River.								
Melville, La	100	31	14.0	31	7.5	21,22	8.9	6.5
Susquehanna River.								
Wilkesbarre, Pa	183	14	5.1	25	1.0	4-9, 19, 20	1.9	4.1
Harrisburg, Pa	69	17	9.0	26	1.2	6	3.5	7.8
W. Br. of Susquehanna.								
Williamsport, Pa	39	20	7.8	25	0.7	5,6	2.7	7.1
Juniata River.								
Huntingdon, Pa	90	24	6.7	31	3.0	1-6, 11-17, 21-23, 28-30	3.5	3.7
Potomac River.								
Harpers Ferry, W. Va	172	16	1.0	9, 10	−3.0	5-7	−1.2	4.0
James River.								
Lynchburg, Va	260	18	8.8	7	0.6	3,4	3.0	8.2
Richmond, Va	111	12	11.8	15	0.2	1	2.5	11.6
Roanoke River.								
Weldon, N. C	129	40	37.7	10	8.4	5	22.4	29.3
Cape Fear River.								
Fayetteville, N. C	112	38	44.8	9	3.6	5	21.4	41.2
Edisto River.								
Edisto, S. C	75	6	4.9	14	2.3	4-10	3.8	2.6
Pedee River.								
Cheraw, S. C	149	27	36.2	8	2.9	5	19.0	33.3
Black River.								
Kingstree, S. C	60	12	6.0	22	3.5	6,7	4.7	2.5
Lynch Creek.								
Effingham, S. C	35	12	14.6	13	3.8	5	7.8	10.8
Santee River.								
St. Stephens, S. C	50	12	13.6	25	5.1	7	9.0	8.5
Congaree River.								
Columbia, S. C	37	15	17.8	18	1.0	5	7.5	16.8
Wateree River.								
Camden, S. C	45	24	30.2	8	5.0	1,5	19.9	25.2
Waccamaw River.								
Conway, S. C	40	7	8.4	1	4.6	16,17,23,24	5.9	3.8
Savannah River.								
Calhoun Falls, S. C	347	15	13.3	28	2.7	5	5.6	10.6
Augusta, Ga	268	32	29.0	29	7.0	4	15.8	22.0
Broad River.								
Carlton, Ga	30	11	10.0	6	2.3	2-5	4.9	7.7
Flint River.								
Albany, Ga	80	20	9.6	31	0.7	1	5.1	8.9
Chattahoochee River.								
Westpoint, Ga	239	20	17.1	24	2.8	4	6.5	14.3
Ocmulgee River.								
Macon, Ga	125	18	14.6	17	2.2	4,5	6.8	12.4
Oconee River.								
Dublin, Ga	79	30	10.3	31	0.5	6	5.1	9.8
Coosa River.								
Rome, Ga	271	30	23.2	24	1.6	4,5	7.4	21.6
Gadsden, Ala	144	18	20.0	24	0.9	1-6	8.4	19.1
Alabama River.								
Montgomery, Ala	265	35	23.0	25	2.2	1	9.6	20.8
Selma, Ala	212	35	24.8	27	2.6	2,3	11.1	22.2
Tombigbee River.								
Columbus, Miss	303	33	15.9	22	−3.5	3	3.0	19.4
Demopolis, Ala	155	35	34.2	25	−2.3	5,6	3.3	36.5
Black Warrior River.								
Tuscaloosa, Ala	129	43	32.5	22	0.2	10,11	10.2	32.3
Brazos River.								
Kopperl, Tex	369	21	1.8	1,2	0.0	23-31	0.4	1.8
Waco, Tex	301	22	2.6	4	0.4	1	1.4	2.2
Booth, Tex	76	39	1.1	13, 14	0.0	3-10, 30	0.4	1.1
Red River of the North.								
Moorhead, Minn	418	......	8.3	1	7.8	29-31	8.1	0.5
Columbia River.								
Umatilla, Oreg	270	25	11.7	1	7.0	31	9.2	4.7
The Dalles, Oreg	166	40	17.9	1	9.9	31	13.7	8.0
Willamette River.								
Albany, Oreg	119	20	1.3	1	0.8	10-31	0.9	0.5
Portland, Oreg	12	15	9.2	1	4.7	23-25	6.7	4.5
Sacramento River.								
Red Bluff, Cal	265	23	−0.1	1-7	−0.3	17-31	−0.2	0.2
Sacramento, Cal	64	29	8.5	1	7.6	23-27	8.0	0.9

*Thirty days only.

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Chart I. Tracks of Centers of High Areas. August, 1931

Chart I. Tracks of Centers of High Areas. August, 1901.

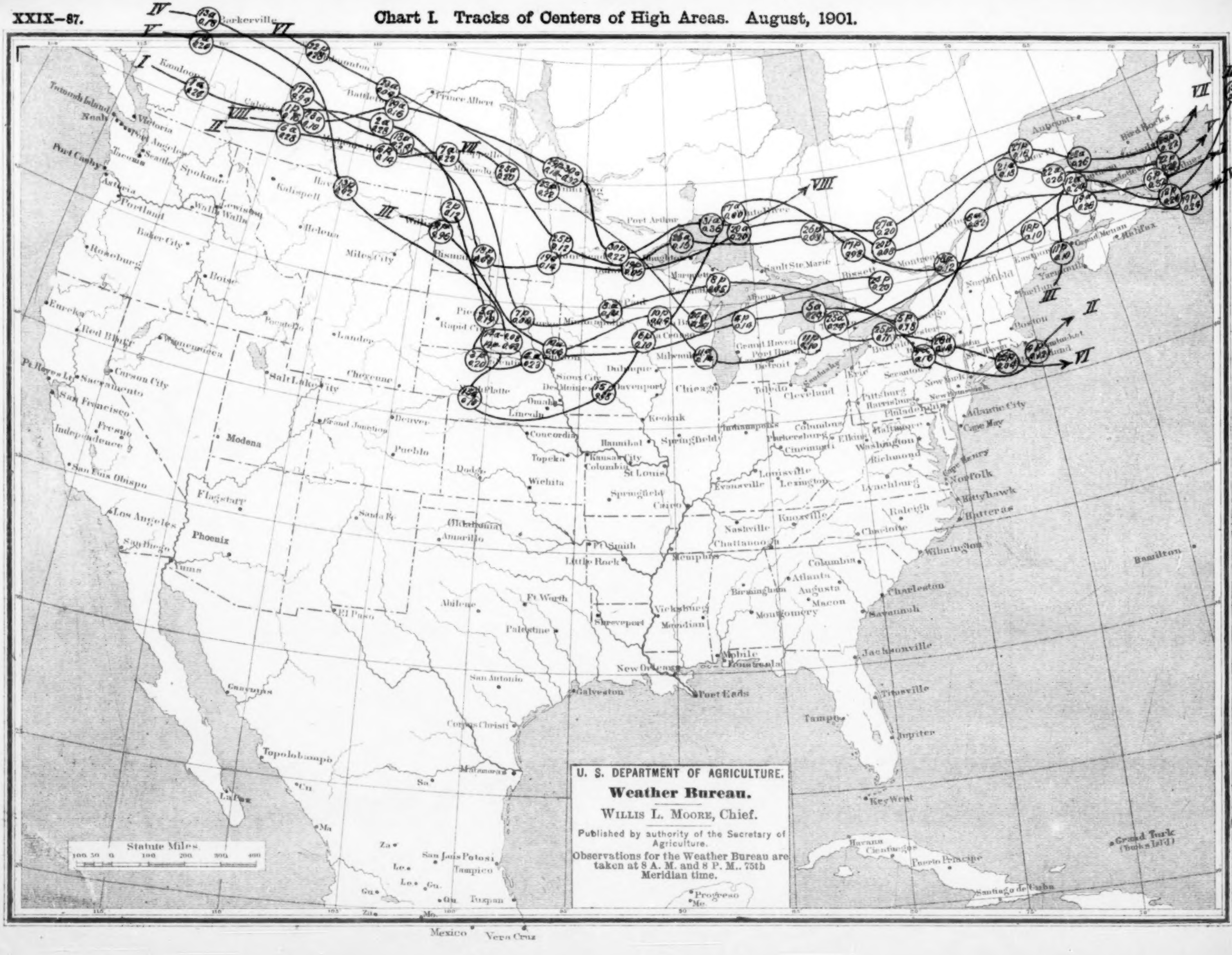

Chart II. Tracks of Centers of Low Areas. August, 1901.

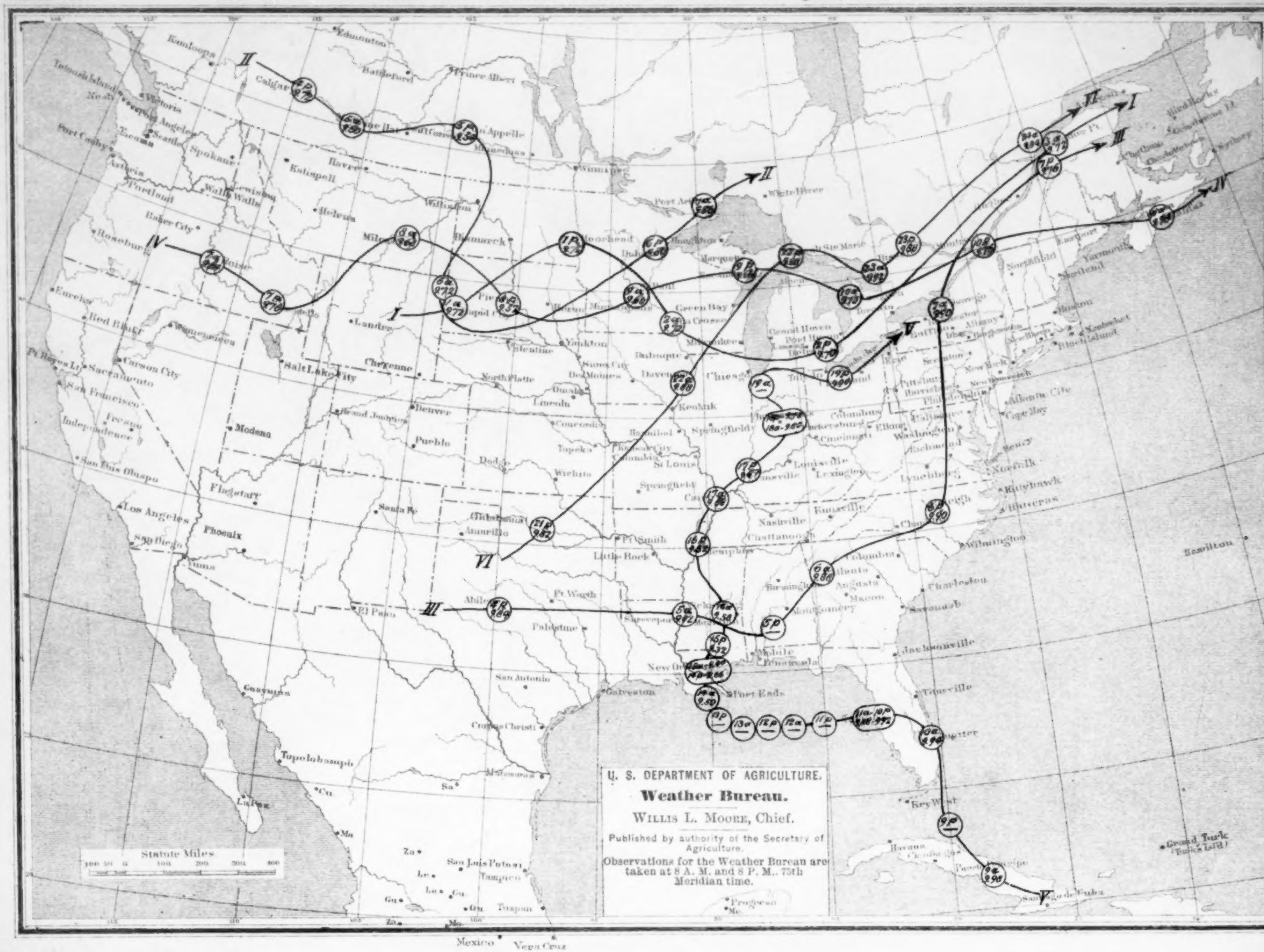

Chart III. Total Precipitation. August, 1901.

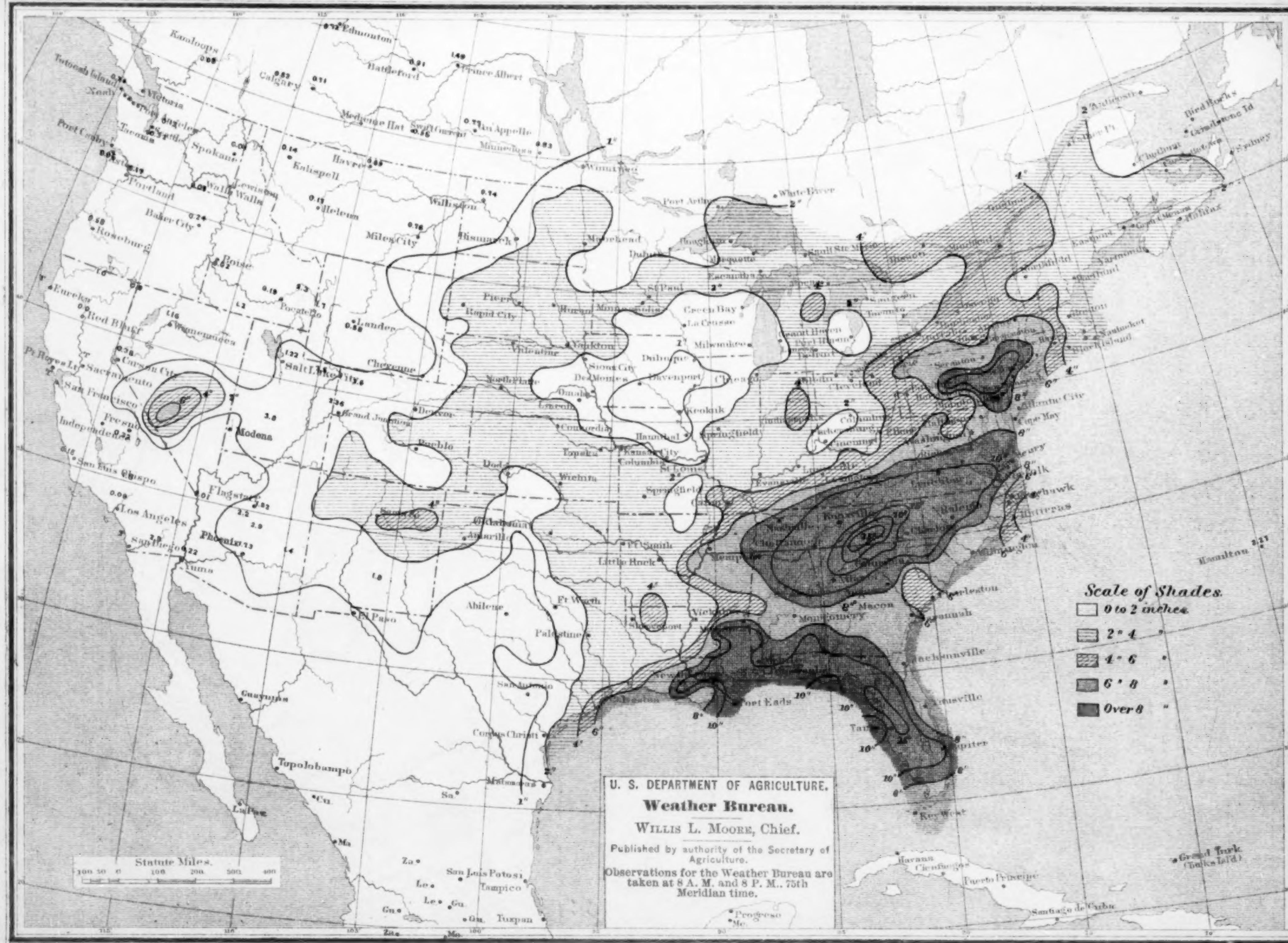

Chart IV. Sea-Level Pressure and Temperature; Resultant Surface Winds. August, 1901.

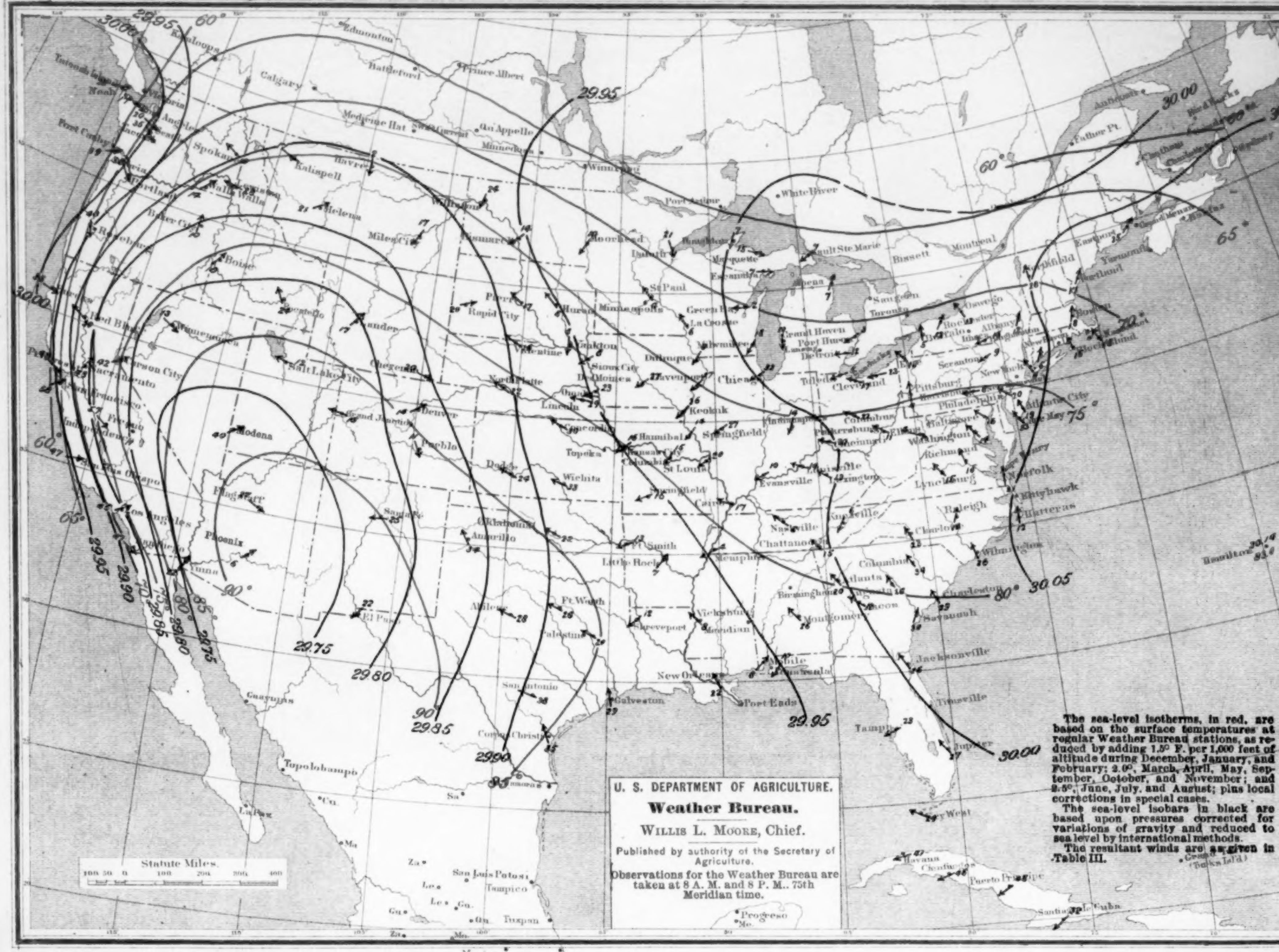

Chart V. Hydrographs for Seven Principal Rivers of the United States. August, 1901.

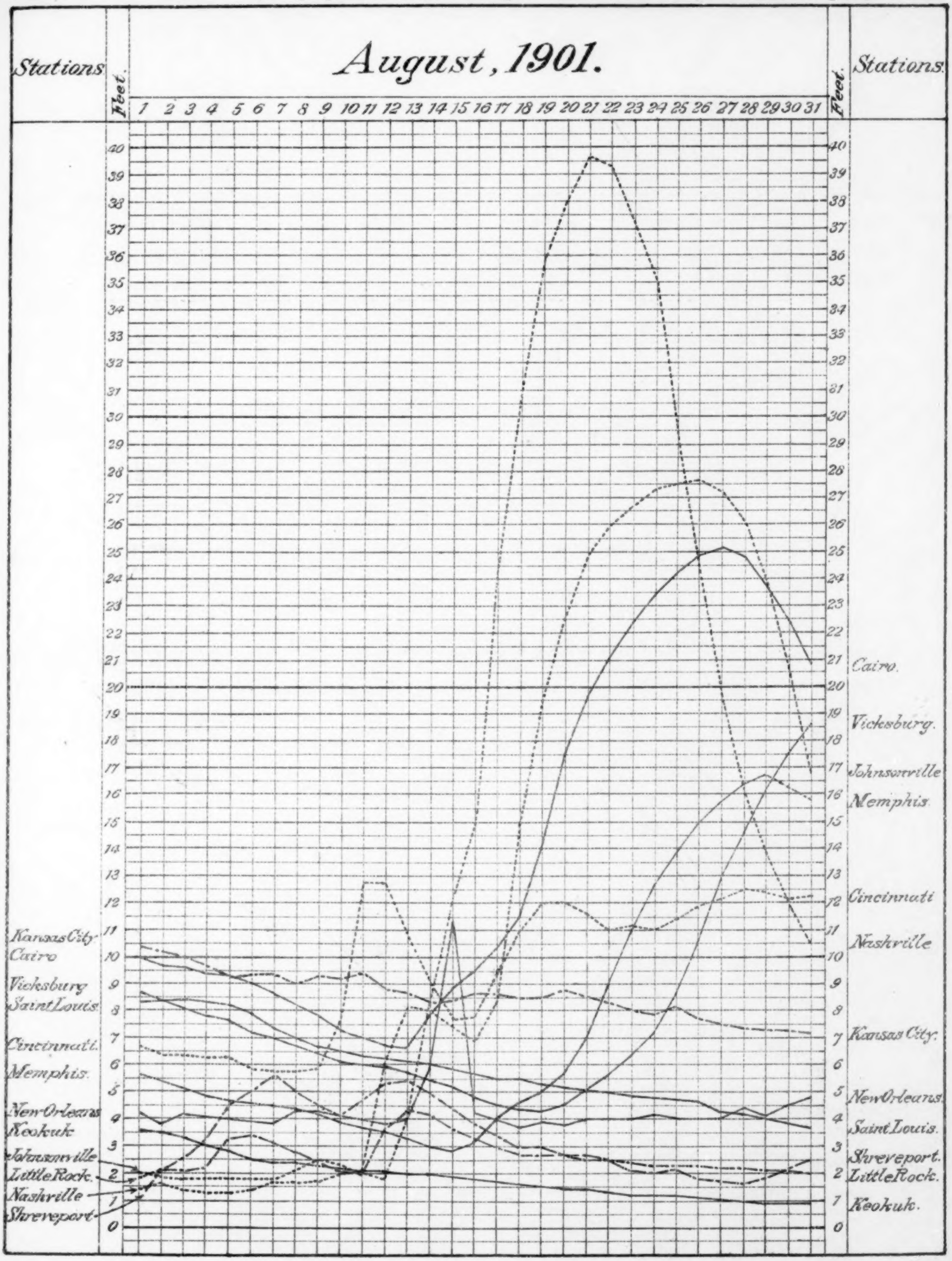

Chart VI. Surface Temperatures; Maximum, Minimum, and Mean. August, 1901.

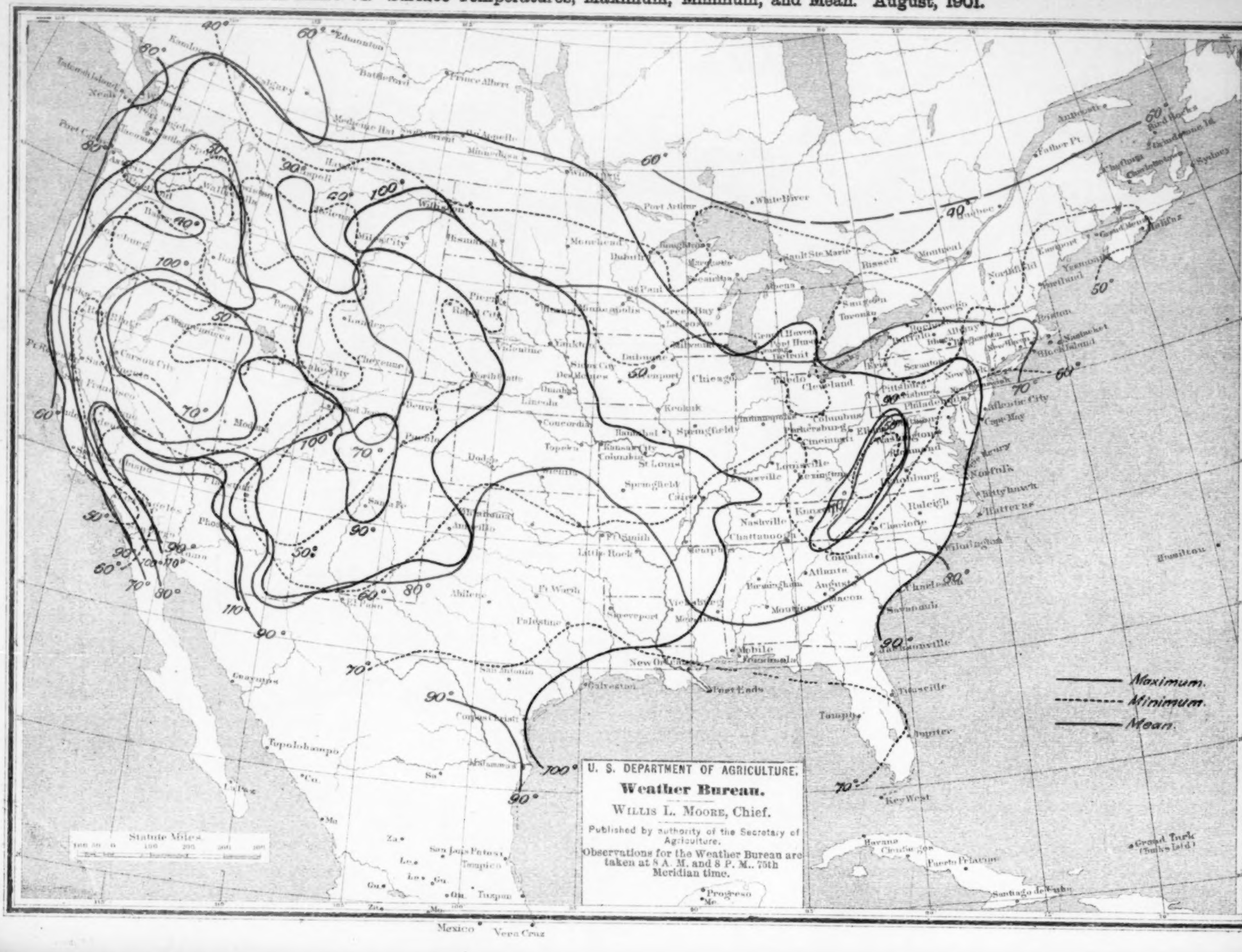

Chart VII. Percentage of Sunshine. August, 1901.

Chart VII. Percentage of Sunshine. August, 1901.

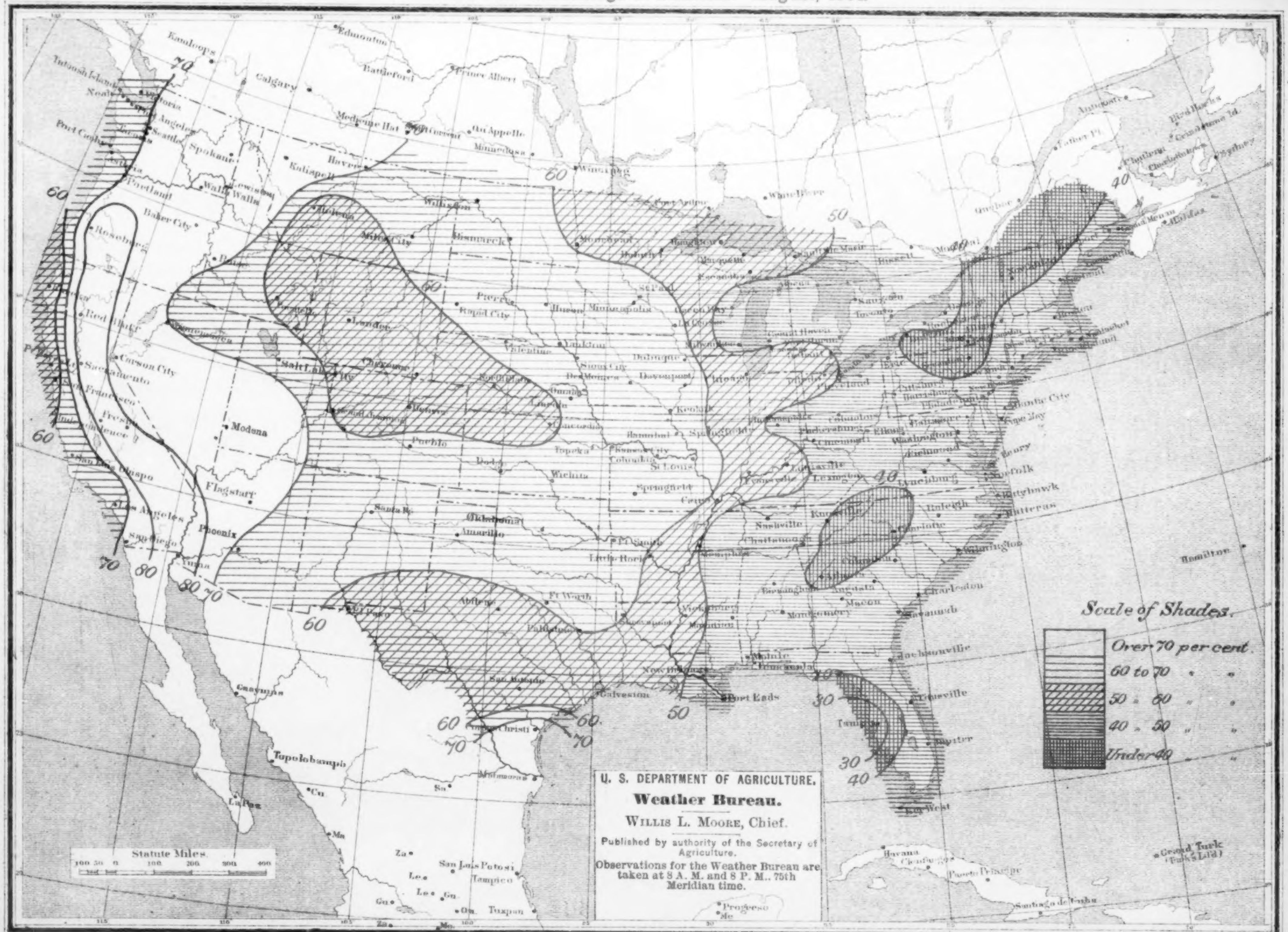

Chart VIII. West Indian Monthly Isobars, Isotherms, and Resultant Winds. August, 1901.

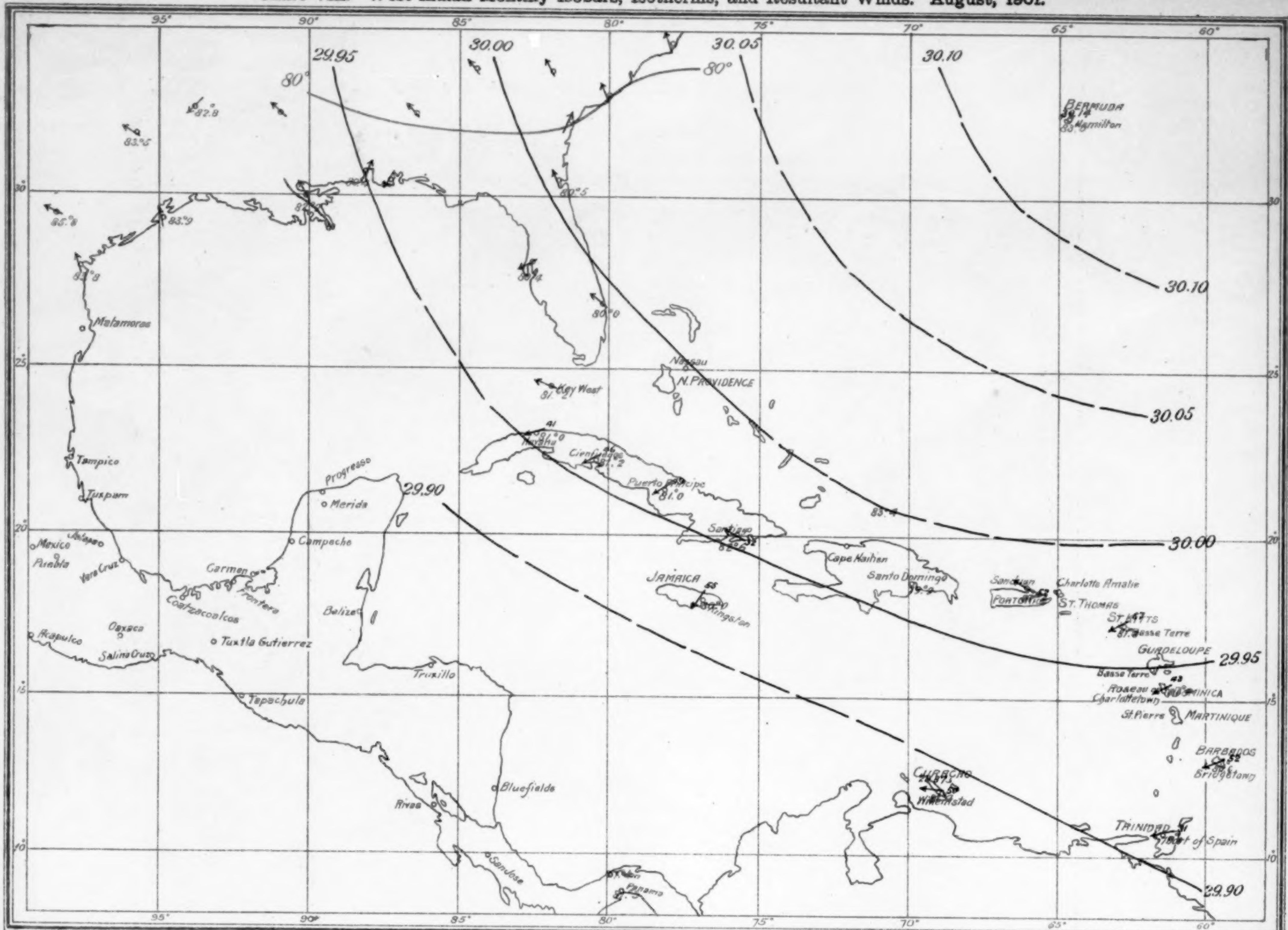

FIG. 1.—Ice bed, Northford, Conn.

FIG. 2.—Ravine near ice bed, Northford, Conn.

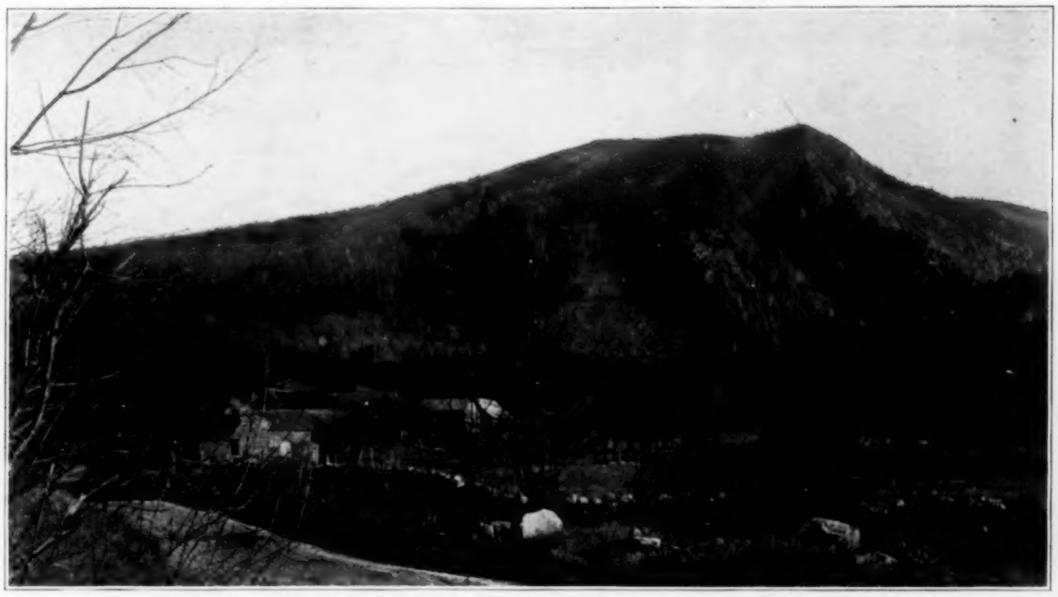

FIG. 1.—White Rock Mountain, Wallingford, Vt.

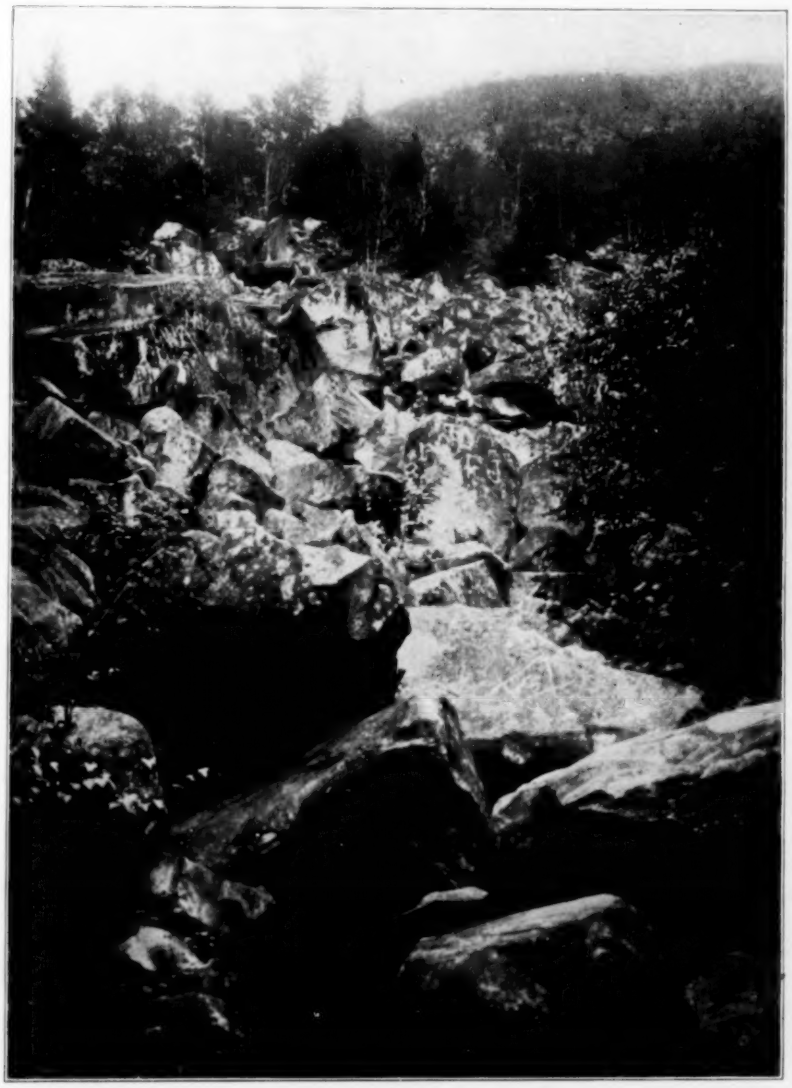

FIG. 2.—Talus at base of White Rock Mountain.

Fig. 1.—Terminus, overlooking Otter Creek.

Fig. 2.—Gravel pit near frozen well.

Fig. 3.—Conglomeritic formation, between the pit and well.